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SOLID WASTE DISPOSAL

Ohio Legislative Service Commission
Columbus, Ohio

December 1970

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Solid Waste Disposal

STAFF RESEARCH REPORT NO. 100

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STAFF RESEARCH REPORT NO. 100

OHIO LEGISLATIVE SERVICE COMMISSION

David A. Johnston, *Director*

Columbus, Ohio

December, 1970

RESEARCH STAFF

John P. Bay, *Project Officer*

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Photos: Leo M. Wilhelm

PREFACE

The Ohio General Assembly has shown growing concern in recent years over the problem of solid waste disposal as it relates to combating pollution and protecting the natural environment. The resolution which first requested this study (H. R. 92) was introduced in the 108th General Assembly in June, 1969. On October 10, 1969, the Legislative Service Commission adopted the motion:

> . . . that the staff study the solid waste disposal problem, including a review of present disposal practices, the feasibility of alternative methods of disposal, and alternatives for legislative consideration to help resolve the problem . . .

At its June 19, 1970 meeting the Legislative Service Commission expressed its concern over cost and duplication in disposal practices. It further directed that the study:

> . . . be continued and supplemented by specific consideration of the problems created by individual community waste disposal and treatment systems in areas which could be served by a regional system, the feasibility of such regional systems, and whether additional legislation is needed to promote the establishment of regional systems should they be found feasible.

This report consists solely of information, conclusions, and legislative alternatives prepared by the research staff. It does not purport to represent the findings or recommendations of the Legislative Service Commission itself. The Commission has authorized the publication of this report, but it has taken no position in regard to the material contained herein.

Mr. Donald E. Day, Engineer-in-Charge, Solid Wastes Section, Engineering Division, Ohio Department of Health contributed many useful insights and comments on the technological aspects of this report.

All of the photographs in this study were taken after open burning and dumping were prohibited by state law. Those not credited otherwise were taken by Leo M. Wilhelm. Other photos were contributed by Lloyd Jones of the Youngstown *Vindicator;* the Bureau of Mines, United States Department of the Interior; Fairfield Engineering Co. of Marion; Owens-Illinois of Toledo; and Jeffrey Manufacturing Co. of Columbus. Cartoons were contributed by permission of Guernsey Le Pelley of the *Christian Science Monitor,* and of Johnny Hart and Field Enterprises, Inc., creators of "The Wizard of Id." The map showing disposal methods and locations in the Cleveland-Cuyahoga County area is reprinted by permission of the Governmental Research Institute, Cleveland. The lithograph of the 1887 scene at Mill Creek near Cincinnati is reproduced by permission from *America the Vanishing,* edited by Samuel R. Ogden, The Stephen Green Press, Brattleboro, Vermont, 1969.

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GLOSSARY

Some of the terms in this report, because of their technical nature, may be unfamiliar to readers. Other terms employ familiar words that are used herein in a technical sense applicable to waste disposal and environmental problems. This glossary defines some of these terms, to facilitate understanding of the report.

Air contaminants or pollutants — Dust, soot, fumes, gas, mist, smoke, vapor, odorous substance, or any combination thereof.

Ambient air — the outdoor atmosphere.

Community wastes — solid wastes that are routinely collected from homes, offices, and business firms, and are transported to disposal sites.

Composting — a disposal method whereby bacteria feed on wastes under carefully controlled physical conditions and convert them into a humus-like product (compost) for use as a soil conditioner.

Disposal facility — buildings and equipment (such as incinerators, bulldozers, compactors, and shredders) for processing solid wastes at a disposal site.

Disposal site — any place used for disposal of solid wastes.

Dump — any disposal site where solid wastes are left uncovered for more than one day, or where open burning is practiced.

Economic poison — any substance or mixture of substances intended for use in controlling plant or animal pests, as designated by the Ohio Director of Agriculture pursuant to section 921.11 of the Revised Code.

Effluent — water-borne waste discharged into a stream.

Emission — air-borne waste discharged into the outdoor atmosphere.

Eutrophication — the process whereby waters receiving plant nutrients become progressively enriched, biologically productive, and eventually clogged with dense, nuisance growths of algae and weeds.

Garbage — food wastes.

Incineration — a process of burning solid wastes under controlled physical conditions to minimize the emission of air contaminants.

Leaching — the chemical dissolving and physical removal of mineral and chemical substances from soil or solid wastes by the action of percolating water.

Open burning — burning solid wastes in the open atmosphere or in any chamber or facility not approved in regulations adopted by the Public Health Council.

Open dumping — depositing solid wastes anywhere without compacting and covering them daily in accordance with regulations adopted by the Public Health Council.

Overburden wastes — overlying earth and other materials removed in order to mine coal or other minerals.

Refuse — "garbage" plus "rubbish."

Rubbish — bottles, cans, cartons, plastic and other containers and wrappings, ashes, and other dry materials discarded routinely.

Sanitary landfill — a disposal site where wastes are compacted and covered daily with earth or other cover in compliance with sanitary regulations, to avoid health and environmental hazards.

Sewage sludge — solid materials separated from sewage (most sewage treatment processes involve separation of the liquid and solid wastes; the solids often are disposed of on land).

Slurry — a rotary device for mixing finely ground, solid matter with water or other liquids so that the solids may be carried off.

Solid wastes — any discarded solid or semisolid materials; includes "garbage" plus "rubbish" and "trash."

Tailings — mineral residue from mining operations or disposal sites.

Trash — solid waste material that requires special or seasonal handling, such as prunings and discarded household appliances.

If we had to put it in our yard we'd begin to realize . . .

LePelley in *The Christian Science Monitor*© TCSPS

Chapter I

THE COMMUNITY SOLID WASTE DISPOSAL PROBLEM

1970 has been called the year America "discovered" pollution. Numerous events, topped by the nation-wide observance of Earth Day on April 22, were sponsored as protests against pollution or as programs designed to call public attention to pollution dangers. Some ecologists predicted that if man did not take immediate action to save himself, "life as we know it" would not exist after 1985. Paraphrasing the title of John Kenneth Galbraith's best-seller, one observer of environmental problems claimed Americans live in an "effluent society."

Pollution in Ohio was also discussed frequently in 1970. A national study identified Steubenville as the most polluted city in the United States. *Newsweek* identified the Cuyahoga and Ohio rivers as among the ten most polluted in the nation. The Cuyahoga became the occasional object of television and magazine humor when its polluted condition led to its classification as a fire hazard. Lake Erie was labeled "dead."

A major contributor to pollution and its accompanying adverse effects on the environment is solid waste, which is not only growing in volume but is appearing in forms that make disposal complicated and occasionally unfeasible. Improperly disposed solid wastes augment pollution of air, water, and soils, and produce serious health dangers. The increasing volume of solid wastes presents enormous problems for collection and disposal.

Public dissatisfaction with solid waste's detrimental effects on environment and health has led federal, state, and local governments to undertake a variety of programs aimed at more effective solid waste disposal. This study focuses on Ohio's present policies and practices regarding solid waste disposal, and suggests some alternative programs for legislative action. Ohio may not be able to solve today's solid waste problems by itself; cooperation with other states and the federal government may be necessary to realize substantial improvements in disposal of solid wastes. Effective state-level action, however, can do much to alleviate Ohio's solid waste problems.

This study particularly emphasizes Ohio's involvement in solid waste disposal at the community or local government level. Traditionally, solid waste disposal in Ohio has been conducted by local governments or by private enterprise. However, the growing problems that communities face in solid waste disposal, and the increasing costs of disposal, have induced suggestions that the state take a more active role in helping communities dispose of solid waste.

Trends in Waste Quantities and Types

The volume of solid wastes produced in the United States and Ohio grows more rapidly each year. Changes in the composition of solid wastes, combined with this increasing volume, compound the difficulties of solid waste disposal efforts.

State health department engineers estimate that the average Ohioan discards 5.3 pounds of refuse and trash per day, or more than 1800 pounds each year, at least as much as the national average. In more dramatic terms, each day Ohioans produce enough solid wastes to fill a railroad train 15 miles long.

Most Ohio communities do not measure the amounts and types of wastes they dispose of. The 1968 statewide survey of community solid waste disposal practices conducted by the Ohio Department of Health confirmed the applicability in Ohio of the U.S. Bureau of Solid Waste's national findings: the typical municipal corporation or county keeps little or no data on the quantity and physical characteristics processed at its dump, landfill, or incinerator. Routine weighing and recording of wastes by type has been instituted only re-

cently at sanitary landfills and incinerators. Based on the fragmentary information available from the few Ohio cities where accurate waste disposal records are kept, health department engineers estimate that wastes are generated at no less than the national average rate and probably somewhat greater, since Ohio is an urban, highly industrialized state.

The quantity of wastes produced nationally is increasing more rapidly than the population. The current 5.3 pounds per person is almost twice the 1920 level, the U.S. Public Health Service reports. The Service's national solid wastes survey estimates that by 1980, the 1920 level of waste production will likely be tripled. Per capita use of packaging nationally was 404 pounds a year in 1958, 525 pounds in 1966, and is estimated to reach 661 pounds by 1976.

Communities' problems of coping with the growing volume of wastes are compounded by the changing composition of solid wastes. An increasing share of solid wastes is highly resistant to decomposition. Today's refuse is denser, dryer, bulkier, and contains more combustible materials than that of 15 years ago. The percentage of garbage (food wastes) in refuse (garbage plus "rubbish" [cans, bottles, packaging]) has declined from 50 per cent to about 20 per cent since 1920. Packaging now represents about 20 per cent of all household waste.

Economic growth has brought about changes in marketing practices and consumer behavior that in turn have increased wastes' resistance to decomposition. Changes in marketing and packaging techniques, such as the growing use of plastic bottles and food wrappings, metal cans, pop-tops, and aerosol containers, have produced more rubbish. By 1976 nonreturnable containers will virtually displace the deposit-type bottle. Since each returnable bottle makes about 19 round trips before it is retired, each returnable bottle eliminated will require production of 19 nonreturnable containers. People have switched from coal and wood fuels to gas, oil, and electricity, thereby reducing the amounts of ash and other contents of household wastes that will burn at low temperatures. The high quantities of metal, glass, and plastic packaging and containers now found in most household wastes require high temperatures to burn them, sometimes produce noxious gases, and often damage incineration equipment.

Table I illustrates projected changes in the composition of typical city refuse.

The concentration of population in metropolitan areas aggravates the disposal problem. Hamilton and Cuyahoga counties are virtually running out of space for disposal purposes. Residents who live near the remaining physically suitable sites for disposal vocally oppose such land use. Cleveland residents decry landfilling practices along the Lake Erie shoreline. The occasional fires and rubbish piled in full view along the outerbelt and along Alum Creek arouse complaints from Columbus area residents. When antiquated incinerators (like the teepee burner at the intersection of I-75 and I-275 North of Cincinnati) emit black columns of sooty smoke, many local residents complain to the city or county health department.

Adverse Effects

The most extensive adverse consequence of solid waste disposal practices is the deterioration of the natural environment. Disposal activities contribute to air, water, and soil pollution in ways that are often inconspicuous and unobserved.

Air pollutants. The incineration of paper, leaves, garbage, ashes, metal, glass, and other refuse emits five million tons of the 145 million tons of pollutants emitted into the atmosphere annually in the United States from all air pollution sources. The U.S. Public Health Service estimates that air pollution from solid waste sources includes about equal amounts of carbon monoxide, sulphur oxides, nitrogen oxides, hydrocarbons, and particulate matter. Occasionally, refuse contains substances—such as sulphur, nitrates, or fluorides — that when burned create immediate health hazards.

The amounts of air contaminants discharged by various disposal methods are compared in Tables II and III. Table II shows the air contaminants discharged by three common municipal disposal methods: incineration, open burn-

TABLE I
PROJECTED AVERAGE REFUSE COMPOSITION (PERCENT OF TOTAL WEIGHT)*

Refuse Category	1970		1980		2000	
	Seasonal	Non Seasonal	Seasonal	Non Seasonal	Seasonal	Non Seasonal
Glass	9.1	7.9	10.3	9.0	8.1	7.2
Metal	8.8	7.6	9.3	8.1	7.4	6.5
Paper	39.1	33.5	41.5	36.1	49.7	43.5
Plastics	1.3	1.1	2.8	2.5	4.2	3.8
Leather & Rubber	1.5	1.3	1.5	1.3	1.6	1.4
Textiles	2.0	1.8	2.1	1.9	2.8	2.5
Wood	2.5	2.2	2.0	1.7	1.3	1.2
Food Wastes	20.2	17.4	16.2	14.1	12.1	10.7
Miscellaneous	1.7	1.5	1.4	1.2	1.0	0.9
Yard Wastes	13.8	25.7	12.9	24.1	11.8	22.3
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Seasonal State—e.g., Massachusetts
Non-Seasonal—e.g., Florida

* As discarded basis

Source: Arthur D. Little, Inc. for the National Air Polution Control Administration.

TABLE II
POUNDS OF AIR CONTAMINANTS DISCHARGED DAILY FROM MUNICIPAL SOURCES IN A METROPOLITAN AREA OF 100,000 PERSONS USING VARIOUS REFUSE-DISPOSAL METHODS

Principal Contaminants	Pounds per Day per 100,000 Persons Using Each Category of Refuse Disposal		
	Incineration	Burning Dumps	Sanitary Landfill
Oxides of sulfur	290	180	—
Oxides of nitrogen	320	90	—
Hydrogen sulfide	—	—	Trace
Ammonia	45	345	Trace
Aldehydes (formaldehyde measured)	168	600	—
Organics	210	42,000	Trace
Organic acids (acetic acid measured)	90	225	—
Solids	3,450	7,000	Variable [a]
Total of above categories	4,570	50,400	Low

(a) Depends on amount of ashes being placed and amount of dust in cover material. Can be controlled.

Source: Rolf Eliassen, "Domestic and Municipal Sources of Air Pollution," *Proceedings National Conference on Air Pollution*, Public Health Service, U.S. Department of Health, Education, and Welfare, 1959, pp. 132-139.

ing at dumps, and sanitary landfill. Table III compares the contaminants produced by three domestic or household disposal methods (backyard burning, household incinerators, and apartment incinerators), with the air contaminants produced by heating households by coal (used in generating electricity), oil, and gas. All of the estimates are based upon typical uses for a metropolitan area population of 100,000 persons.

TABLE III

POUNDS OF AIR CONTAMINANTS DISCHARGED DAILY FROM DOMESTIC SOURCES IN A METROPOLITAN AREA OF 100,000 PERSONS

Principal Contaminants	Pounds per Day per 100,000 Persons Using Each Category of Heating and Refuse Disposal					
	Fuel—Domestic Heating			Domestic Incineration		
	Coal, 1000 tons	Oil	Gas	Backyard Burning	Household Incinerators[b]	Apartment Incinerators
Oxides of sulfur	42,000	17,000	0.4	180	1	12
Oxides of nitrogen	8,000	6,000	6	90	1,150	30
Hydrogen sulfide	1,000	500	0.1	—	—	24
Ammonia	2,000	800	0.3	345	—	24
Hydrogen chloride	2,000	500	0.3	—	—	—
Aldehydes (formaldehyde measured)	2,000	800	1	600	8,400	72
Organics	20,000	4,000	1	42,000	12,000	1,800
Organic acids (acetic acid measured)	30,000	12,000	1	225	1,900	4,800
Solids	200,000	800	0.1	3,400	16,500	4,000
Total of above categories[a]	307,000	42,400	10	46,800	40,000[b]	10,700

(a) Total includes only above categories and does not imply total contamination in the ambient atmosphere.

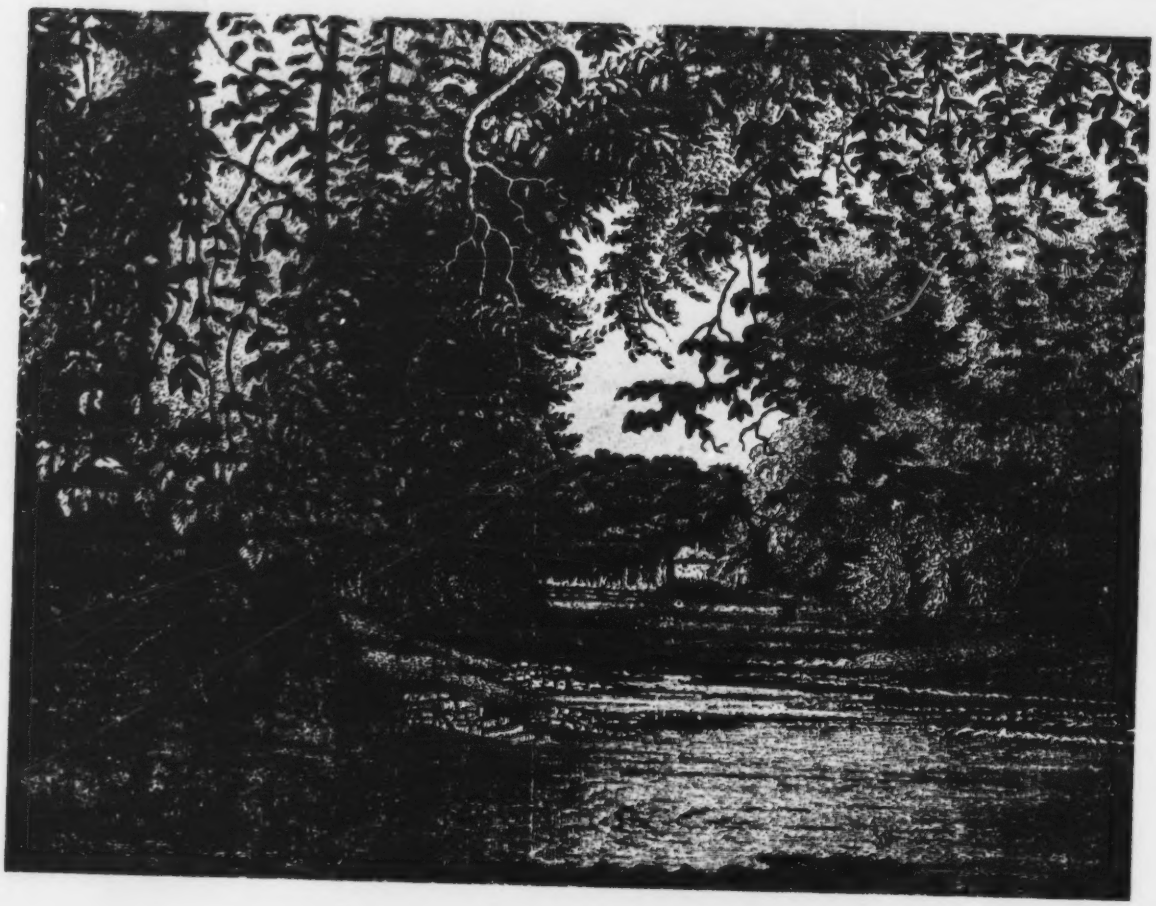
(b) The contributions listed for household incinerators are considered high. General use of high gas input domestic units with after-burners would significantly lower contributions from this source.

Source: Rolf Eliassen, "Domestic and Municipal Sources of Air Pollution," *Proceedings National Conference on Air Pollution*, Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, 1959, pp. 132-139.

As Tables II and III indicate, relatively low air pollution results from sanitary landfills and municipal incineration. Open burning at dumps and backyard burning produce the most air contaminants among disposal methods. Among the three fuels listed, coal produces the most air contaminants.

Water pollution. Solid waste disposal also contributes to water pollution, but this phenomenon often escapes public attention. The extent of the problem may be dramatically visualized if one takes a drive along Ohio's principal streams or lakeshores, imagines how the landscape looked, say, 50 years ago (see illustrations on pages 6 and 7), and makes a mental comparison with the present scene. Many marshes and swampy areas that once provided wildlife habitat, supported extensive commercial and sport fishing, and retarded the runoff of nutrients into Lake Erie and major rivers, have disappeared altogether. The biggest contributor to the eutrophication or aging of Lake Erie with dense, odorous algae growth is phosphate-based detergents, which are usually purchased in solid form but reach the lake and streams via sewer systems.

Once picturesque river valleys, such as Mill Creek in Cincinnati, or the Cuyahoga River in Cleveland and Akron, have been converted into industrial wastelands. Streambanks like that of Alum Creek in Columbus have been bespoiled by litter and used as dump sites. Poisonous substances leached from open refuse dumps and poorly engineered landfills have contaminated surface and groundwaters. Contamination of water from tailings may be especially hazardous when such poisonous elements as copper, arsenic, or radium are leached from dumping sites.



Mill Creek in 1887 *The Stephen Greene Press*

Soil pollution. Concern about the long-range effect of refuse dumping on nearby soils is comparatively recent. It is estimated that a sanitary landfill will leach about 1.5 tons of sodium with potassium, one ton of calcium with magnesium, 0.91 tons of chloride, 0.23 tons of sulphate, and 3.9 tons of bicarbonate from each acre of surrounding soil. Lands adjoining a landfill are not considered prime sites for agricultural or residential use.

Health hazards. Open dumps and incinerators where refuse is permitted to lie uncovered provide breeding grounds for rats, flies, and other disease carriers. Potentially fatal diseases such as encephalitis (carried by insects) and rabies (carried by rodents) may be spread in areas where refuse collection and disposal is infrequent. Inner-city infants in densely-populated low-income ghettoes suffer the most frequent occurrence of rat-bite, attributable to inadequate trash collection and the widespread prevalence of litter in many such areas. The backyard burning of chlorinated plastics such as polyvinyl chloride bottles involves toxic hazards.

Mill Creek in 1970

Increased Disposal Costs

Producing a better environment through improved solid waste disposal will require substantial governmental expenditures. Although economic and social costs resulting from deficiencies in existing solid waste disposal practices are difficult to ascertain, they are substantial.

Improvements in disposal practices will necessitate increased expenditures for collection and disposal services that already cost nationally on the order of $4.5 billion a year. The U. S. Public Health Service estimates the additional expenditure necessary to prevent health and environmental abuses to be $835 million a year, an increase of about 20 per cent a year, over the next five years.

Improved disposal practices will ultimately impose higher disposal service costs on local taxpayers and users of refuse collection and disposal systems. In Ohio, the direct costs of disposal services are borne by local governments and their citizens, who pay for disposal services through taxes or special user charges. Waste collection and disposal services are traditionally a function of municipal government, and to a lesser extent, of county or township government. Roughly half the solid waste dis-

posal facilities in Ohio are owned and operated by municipalities, counties, or townships. About one quarter of the total are owned and operated by private contractors, and the remaining quarter are publicly owned but operated by private garbage and refuse collection firms under contract. In all of Ohio's 13 largest cities garbage and refuse collection and disposal services are paid from city tax revenues. User charges are the predominant means of financing collection and disposal services in Ohio suburbs and smaller cities.

Ohio Health Department engineers estimated, in January of 1970, that $10,000,000 in capital improvements were needed immediately to upgrade disposal facilities throughout the state. An unestimated additional amount, on the order of several more millions of dollars, was acknowledged to be needed immediately for modern incinerators to serve the Cleveland and Cincinnati areas. The department's estimates were based on known inadequacies and deficiencies in capacity of existing facilities, and did not take into account future needs. Based on Ohio's population and U. S. Public Health Service estimates of disposal facility needs across the nation, Ohio will require some $60,000,000 in new and improved disposal facilities over the next five years. The cost of operating disposal facilities is also expected to rise.

The National Community Solid Waste Practices Survey conducted by the U. S. Public Health Service in 1968 indicated that at least $835 million per year for five years are required, nationally, to upgrade collection and disposal practices to a satisfactory level (an increase of about 18.5 per cent). To accommodate the increase expected in packaging wastes alone across the nation will require five million additional collection trips in 1976 that were not necessary in 1966, and an addition of 9,500 more collection vehicles at a cost ranging from $135 million to $190 million.

Indirect Costs

Traditionally, the indirect costs of solid waste disposal (or the failure to dispose of solid waste) have been ignored. But these indirect costs, which include environmental damages, higher recreation costs, denied recreational opportunity, loss of property value, and economic costs of health hazards, are pertinent to an understanding of the total cost of the solid waste problem. Additionally, the value of materials that are thrown away rather than recovered and reused must be considered a part of the total cost picture. When all these elements are considered, an apparently inexpensive method of dealing with solid waste may prove a most expensive policy.

Unfortunately, the indirect costs are difficult to estimate. No one has developed a method of quantifying the costs of lost recreational opportunities. Industries have not conducted systematic cost analyses of the value of goods that have been discarded rather than recovered and reused. Computation of the health costs and environmental damages resulting from solid waste disposal is impossible. Nevertheless, these indirect costs must be considered in developing waste disposal policies.

Chapter II

METHODS OF SOLID WASTE DISPOSAL

The first part of this chapter discusses the prevailing methods of solid waste disposal in Ohio: open dumping and burning, landfill, and incineration. The second section discusses alternative methods not in general use in Ohio: composting, rail-haul, heat and electric power generation, grinding, volume reduction methods, separation and salvage for industrial reuse, and the atomic fusion torch. One other method now used to some degree in Ohio, feeding hogs boiled garbage, is increasingly questioned by state health officials and is rapidly being discontinued in favor of other disposal methods; hence, it is not discussed in this report.[1]

PREVAILING METHODS

Open Dumping and Burning

Open dumping and burning are the most-used solid waste disposal methods in Ohio and in the United States. Public health officials tend to view the methods unfavorably, however, because the methods can contribute to health hazards.

The U. S. Bureau of Solid Waste Management defines a "dump" as any site where solid wastes are left uncovered for more than one day. A dump thus may be a relatively well managed disposal site, or it may simply be a place where solid wastes are left, with little or no management. The chief advantages cited for dumps are that they are relatively inexpensive, and can be operated with few personnel.

Table IV, prepared by the Midwest Research Institute showing dominant use of disposal methods in 1966 and anticipated use in 1976, suggests that open dumping and burning will continue to be practiced extensively in the United States. Although these practices are now illegal in Ohio, the study staff observed violations, and abuses are likely to continue until expenditures are made for improved disposal facilities and methods.

State and federal public health authorities regard open dumping and burning as hazardous, particularly because these methods can produce air and water pollution, rodent and insect infestation, and disease. Other criticisms include excessive demands on health and fire department time and land value depreciation, as well as the stench and general unsightliness of dump areas. Such "hidden costs" of open dumping and burning, most health officials contend, outweigh the illusion of economy associated with these methods of solid waste disposal. Accordingly, these officials advocate total replacement of dumps by sanitary landfills or other disposal methods less detrimental to the environment and health.

Ohio's Department of Health reports that since the 1967 enactment of the Solid Waste Disposal Facility Licensing Law, 418 dumps and landfills were licensed[2] and an estimated 400 disposal sites closed. About 200 sites were

1. Feeding hogs uncooked garbage is prohibited by law in every state and by the federal government. To insure necessary and adequate protection of people and hogs pathogenic organisms must be destroyed. This requires that food wastes be boiled for at least thirty minutes. Chapter 942 of the Ohio Revised Code requires an annual $50 license from the Department of Agriculture to feed hogs garbage so boiled. As of October, 1969, 77 licenses were currently in effect. Licenses mainly include commercial disposal firms that contract to pick up garbage from hotels and restaurants and dispose of it by hogfeeding, and county homes and state institutions. The number of licenses has halved since 1967, when 157 premises were under inspection. In that year the General Assembly established the annual $50 license fee, in lieu of a mandatory but free annual permit. Each year a few more states prohibit the practice of feeding garbage to hogs altogether.

2. These figures were current as of May, 1970.

closed each year, though these were economically marginal and followed exceedingly abusive practices.

The 400 dumps which have been closed still present limited problems. Although the rodent and insect populations supported by such dumps must leave when their food supply ceases, the foul odors persist longer, perhaps for several years. When water percolates through a dump and its surrounding soils it leaches out noxious chemicals that threaten the quality of nearby streams and groundwaters. This threat may continue for 25 to 30 years after the closing of a land site, health engineers claim. Thus, even though a dump is closed, it may continue to impose problems unless its owner, public or private, reclaims the site.

TABLE IV

RELATIVE DOMINANCE OF DISPOSAL METHODS NATIONALLY 1966 AND 1976

Disposal method	Per cent of solid waste tonnage handled	
	1966	1976
Incineration (a)	14.0	18.0
Sanitary landfill (b)	5.0	13.0
Open dumping (c)	77.5	64.0
Composting	.5	1.0
Salvage (d)	3.0	4.0
Total	100.0	100.0

(a) Includes all disposal by burning—municipal, commercial, industrial, apartment house, and backyard household burners—except burning operations at open dumps or on seagoing barges.

(b) Strictly defined: waste is covered daily.

(c) Includes open dumping, ocean dumping, and casual dumping (litter); burning of waste may be practiced in conjunction with open dumping.

(d) Includes all operations where salvage is practiced, including salvage operation in conjunction with composting, incineration, landfilling, collection, etc.

Source: Midwest Research Institute.

Sanitary Landfill

Sanitary landfills are being used increasingly in Ohio and, when properly designed and operated, are recognized by health officials as a safe and economical method of solid waste disposal. Inability to accommodate all types of solid wastes, scarcity of usable sites, and limited capacity are the most significant disadvantages of landfills.

A sanitary landfill operation reduces the volume of waste by compressing it with heavy compaction equipment, and covers the compressed wastes with earth or suitable fill at the end of each day's operation. The daily earth cover dilutes the chemical demands these concentrated wastes exact of surrounding soils by creating a honeycomb-like structure with layers of earth separating each waste area. Landfills are ordinarily dug beneath the earth's surface or fill in strip mining sites. The use of the word "sanitary" indicates that the landfill is operated under certain health and sanitation standards. (For example, on-site open burning is never practiced at a properly operated sanitary landfill.)

Landfill operations have enjoyed increased use in Ohio, especially in the last 20 years. A 1967 survey by the Ohio Municipal League reported that at least 164 Ohio municipalities claimed to be using landfills. Of these, 90 municipalities owned and operated their own sites, and the rest used either county, township, or privately-owned land. The League survey indicated that the large cities predominantly used landfills and that Cincinnati, Cleveland, Youngstown, Dayton, and some 26 smaller cities used both landfills and incineration.

Data from an unpublished 1968 survey of Ohio community solid waste practices, conducted by the U. S. Bureau of Solid Wastes and the Ohio Department of Health, indicated that 650 landfill and dumping sites were in use among the 904 Ohio communities that reported. Only 11 of these sites, however, were classified by survey standards as "sanitary." Roughly half of the total were owned by public agencies, and half by private interests. However, only 26 per cent of the 650 were operated by private operators; 74 per cent were operated by public agencies. This high percentage of public operation resulted from frequent public leasing of privately owned land for landfill purposes.

Landfill disposal costs in 1969 ranged from $3 to $5 per ton of waste delivered at the site, which compares favorably with the $6.50 to $9 per ton delivered for incineration. Further economies may be achieved if landfills are combined with incineration or other methods of reducing waste volume to increase landfill capacity.

Several arguments exist on behalf of and in opposition to landfills. These are summarized below. First, the advantages of landfills:

1. Waste placed in a sanitary landfill is disposed of permanently; this contrasts with some other disposal methods, such as incineration, where residues require further disposal.

2. A landfill is relatively inexpensive and requires low initial investment compared to disposal methods requiring more elaborate machinery. However, compacting operations may increase the costs.

3. A landfill may be started quickly, once a suitable site is obtained.

4. A landfill can accommodate many types and large quantities of solid wastes, including nonburnable materials that cannot be incinerated.

5. Rodent and insect breeding, and other serious health threats and blighting effects associated with open dumping and burning, can be reduced substantially by use of sanitary landfills.

6. A landfill can be used to reclaim mined and marginal lands for recreational and other uses, and if adequate foundation conditions are

provided, may form structural support for parking facilities and some kinds of buildings.

The disadvantages of using sanitary landfills for solid waste disposal and limitations on their use include:

1. The amount of land suitable for landfills is limited. Selection of a site requires consideration of topographic, soil, drainage, and geological characteristics, and when the only available sites are located outside municipal limits, high transportation costs follow.

2. A potential for ground-water and soil pollution exists if the landfill is not properly planned, designed, and operated.

3. Landfills cannot accommodate all types of solid wastes. Bulky trash, raw sewage sludge, and much industrial waste require special handling and disposal.

4. Salvage of waste materials is difficult in a sanitary landfill operation, without prior segregation of the waste into salvageable and nonsalvageable materials.

5. Landfills can also create public annoyances: equipment operating noise is often comparable to that at an excavation involving heavy equipment. Gases, chiefly carbon dioxide and the explosive gas methane are produced by waste decomposition. Fires, however, are both less likely to occur and more easily controlled in sanitary landfills than in an open dump.

6. Public opposition often compounds the difficulty of obtaining approved sites. For example, the only sites with suitable physical characteristics in the Cincinnati metropolitan areas have been blocked by local resistance.

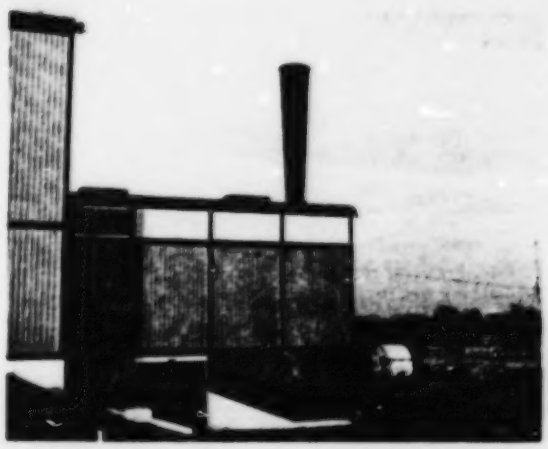
7. The most serious long-range ecological consequence is that even a carefully operated landfill leaches tons of chemicals from supporting and nearby soils, thereby reducing soil fertility.

8. Landfills are only temporary solutions to the solid waste disposal problem, because they can store wastes only up to their capacities. The remaining capacity of all existing landfill sites in Cuyahoga County, for example, is only three years. A complete landfill will settle and require periodic maintenance, particularly if structures are built on top of the landfill.

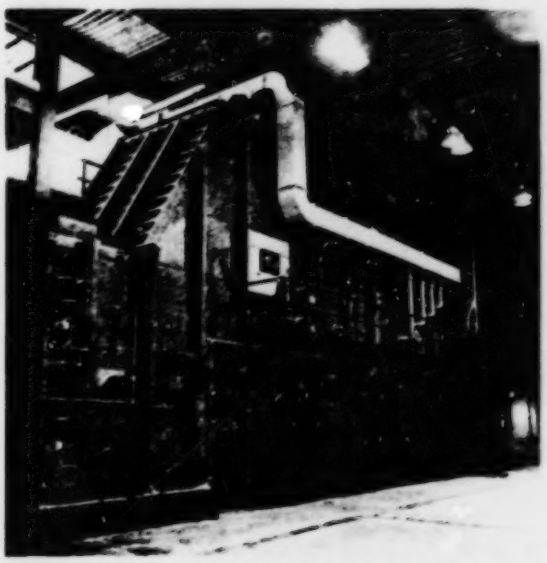
Incineration

Incineration is widely used in Ohio, though less than landfill. Its principal advantages are volume reduction and the possibility of salvaging materials from incinerator residues. Relatively high costs, the need for disposal of residues, and possibilities of air pollution are its principal disadvantages.

Incineration involves burning materials and thereby converting them into water vapor, carbon dioxide, other gases, and ash. Effective use of incineration can reduce the volume of solid wastes by at least 70 per cent, and when operated in conjunction with a sanitary landfill increases the period of time it takes to fill up the landfill.



The 1967 Ohio Municipal League survey reported that 30 municipalities, containing nearly 2.4 million people, used incineration as a disposal method. The 30 included four of Ohio's eight largest cities, each of which allowed other jurisdictions to use the facilities in exchange for payment of tonnage fees. A total of 15 of the 30 communities shared use of their incineration facilities with other communities.



The 1968 survey by the U. S. Bureau of Solid Wastes and Ohio Department of Health reported finding 30 community incinerators, 26 of which were owned and operated by public agencies. It estimated that 2,700 on site incinerators were used in apartment houses, commercial buildings, and institutions in communities containing 3.2 million persons. These facilities were found chiefly in urban areas; some communities required apartment buildings to provide on site incineration facilities, generally without air pollution control equipment.

This survey also reported an estimated 28,000 household incinerators in areas containing 3.1 million persons, or an average of 8.8 incinerators per 1,000 inhabitants in these areas. Many municipalities prohibit backyard incinerators, leaf burning, and similar practices.

The advantages of incineration as a solid waste disposal method include:

1. It provides substantial volume reduction, estimated to be up to 70 per cent reduction when efficiently operated.

2. The volume reduction achieved by incineration can be used to make sanitary landfills more effective, by conserving the capacity of the landfills.

3. Incineration appears to offer significant potential for salvage of residue materials. The 1968 Ohio Health Department survey found salvage operations practiced at 35 per cent of incinerators, but at only 10 per cent of sanitary landfills. The reduction of wastes to noncombustibles apparently renders them more susceptible to modern methods of sorting and salvage, such as use of optical or magnetic sorting equipment.

4. Incinerators can be placed in urban industrial areas, reducing haul distances and the costs associated with transporting solid wastes from the waste-producing and collection areas to the disposal site. The limitations on places for sanitary landfills, discussed earlier, can lead to high costs for transportation to disposal sites.

5. Physical requirements for incinerator facilities pose a relatively minor problem. Land needs are small, plant operation is not dependent on weather conditions, and when properly conducted incineration can produce a relatively stable, odor-free residue.

The disadvantages of incineration include:

1. The cost of incineration is high. Construction costs, including air pollution control devices, run approximately $7,000 to $12,500 per ton capacity. The Solid Wastes Section in the Engineering Division of the Ohio Department of Health indicates from studies that actual capital and operating costs of incineration have in the last few years run about $6.50 to $9 per ton, and will run higher in the future. For a community of 100,000, initial capital costs between $3.2 and $3.6 million can be expected. Health officials find that sanitary landfill usually holds a cost advantage over incineration until round trip hauling distance exceeds 45 to 50 miles from the collection midpoint. A federal demonstration grant to Shippensburg, Pennsylvania, is supporting the evaluation of a small incinerator plant which if successful may allow communities in the 25,000 population range to afford incineration.

2. Highly skilled personnel and continuing maintenance are essential. For example, of the 30 incinerators reported in the Ohio Municipal

League survey, all but one have been found by the Ohio Department of Health to be obsolete in design and in need of modifications to meet air pollution control standards. Only four incinerators are now operating in Cuyahoga County, while five others are inoperable due to plant inadequacies and failure to meet air pollution standards. Apparently, maintenance needs of existing incinerator operations in Ohio have not been filled, and improvements of existing and new facilities will require more trained personnel and financial investment.

3. Improper or inadequate incinerator equipment produces air and land pollution. According to the 1968 solid waste survey, 75 per cent of incinerator facilities in the United States did not meet existing air quality standards. Richard D. Vaughn, chief of the Bureau of Solid Waste Management, estimates that over the next five years $150 million will be required nationally to build new incinerators for replacement of existing inadequate facilities, and an additional $75 million will be needed for air pollution control equipment.

4. Economical operation may be achieved only when the plant serves an area and population large enough to merit continuous operation. The Solid Wastes Section of the Ohio Department of Health estimates that initial capital investment for a new incinerator serving an area with 500,000 or more persons would probably cost $8 to $12 per ton, whereas such costs for an incinerator serving a community of 25,000 might be as high as $15 to $20 per ton.

5. Disposal of residue must be provided. Some of this may be accomplished by salvage operations and use of sanitary landfills, but experience with incineration has shown that disposal of residue has been a difficult problem.

Conclusions

The three prevailing methods of solid waste disposal in Ohio all have advantages and disadvantages, but only sanitary landfills and incineration combined with sanitary landfills can meet existing air and water quality and solid waste disposal standards. A relevant factor in evaluating the three prevalent methods is their capacity to meet existing health standards. Open dumping and burning are assailed by public health authorities because of health hazards described earlier. Incineration's contribution to air pollution, and improperly managed landfills' potentially damaging effects on soil conditions and ground water supplies, are also criticized by health officials.

ALTERNATIVE METHODS

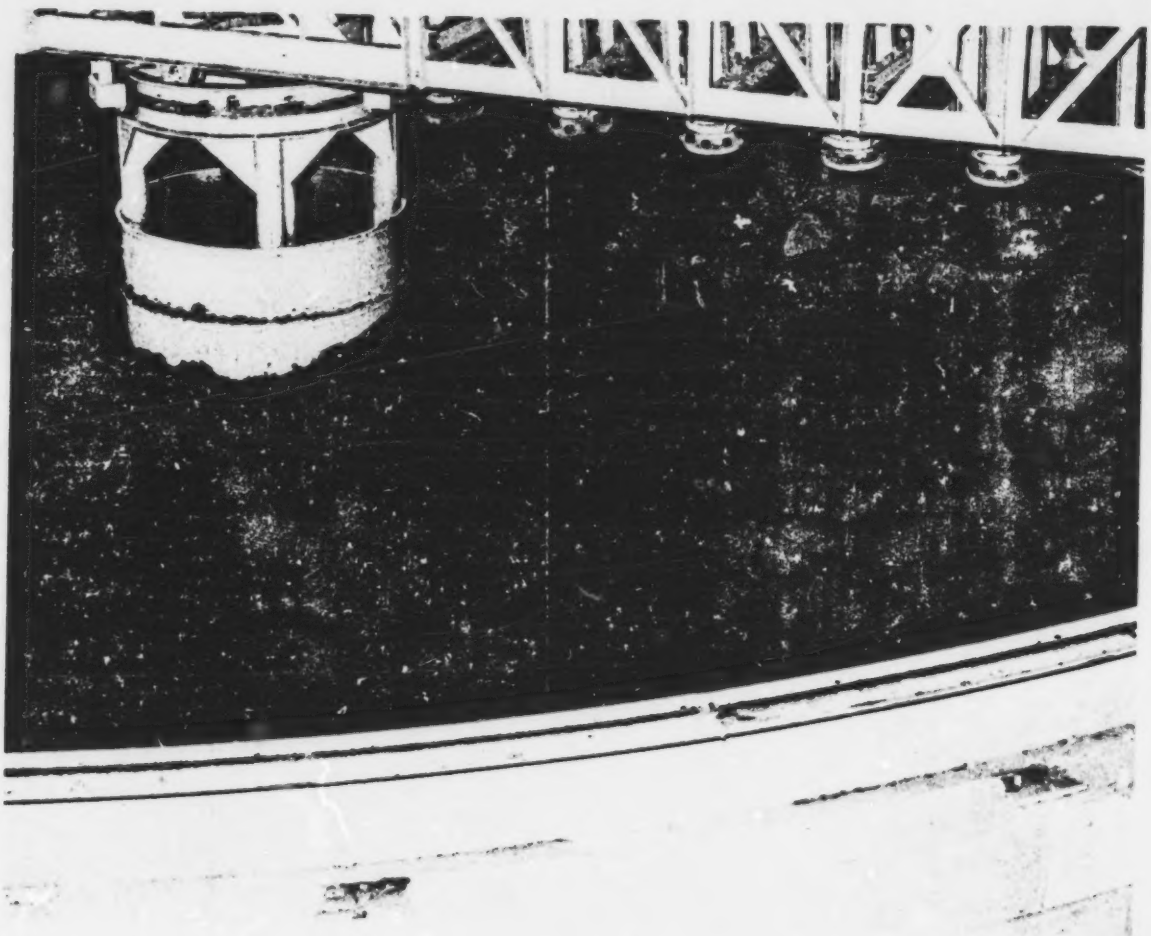
The alternative methods of solid waste disposal that meet present environmental standards are less feasible than sanitary landfill and incineration. None of the methods discussed below is practiced extensively in the United States.

Composting

Composting is a method of processing solid wastes to produce a humus-like material for use as a soil conditioner. Technically, it is the biological degradation of organic matter under controlled conditions of aeration, temperature, and moisture. Bacteria are used to digest refuse and speed the production of compost.

Compost is not a fertilizer but a conditioner used to make soil more manageable and more able to hold moisture. The process requires the separation of noncompostable materials such as metals, glass, and ceramics and their disposal by other means.

The expense of composting is comparable to that of incineration, that is, on the order of $10 per ton, and technically trained personnel are required. Lack of a market is the biggest obstacle to composting, but some potential for this method does exist. A survey of the 18 compost plants in operation or under construction in the United States in 1968 indicated that 12 of the 18 were closed or construction had stopped. The single Ohio plant, at Wilmington, had closed. If local governments cannot sell compost for a profit, they may consider finding



Composting *The Fairfield Engineering Co.*

someone who will accept it free of charge on a regular basis. Or, local governments may be able to use compost to maintain grass, trees, and shrubs in parks and along highway medians and berms. They may even landfill the compost as well as its residue. Experiments are underway in Norman, Oklahoma to determine whether compost can be used for animal feed.

Rail-Haul or Trash Train

Rail-haul, sometimes referred to as "trash train," is basically a variation of landfill disposal. The basic purpose of the methods is to obtain a cheap means of transporting wastes regularly to a distant site, such as a strip mine or abandoned quarry. It involves (1) compaction of refuse prior to its loading into railroad cars, (2) transportation by rail to one or more disposal sites distant from the area served, and (3) landfilling the refuse at the disposal sites. Incinerators might be designed to operate at the disposal sites, but incineration is not

an element of rail-haul systems now being studied. Preliminary cost estimates of rail-haul operation range from $4 to $8 per ton.

The rail-haul method is being evaluated by the American Public Works Association under a grant of funds from the U.S. Public Health Service, the Penn-Central Railroad Company, and several major cities, including Cleveland. The Maryland Department of Health is testing the feasibility of hauling refuse to fill abandoned coal mines. Some major Ohio cities are also considering rail-haul.

Rail-haul appears to offer greatest promise for the removal of solid wastes to strip mine reclamation sites. Such sites can have significant value for recreation purposes, as does "Mount Trashmore," near Chicago which provides a 65 foot sledding hill of incinerator ash.

To date, rail-haul is still in the exploratory and experimental stages. Very little experience with the costs and problems of transporting solid wastes over long distances has been obtained. Equipment to shred or compact waste before it is loaded on a train is still at a developmental stage. Not one contract for rail-haul is in effect and operating. San Francisco recently rejected a railroad proposal because the city desired a 20-year contract (the railroad

Landfill in strip mine

offered a commitment for 10 years) and because of differences with the railroad over performance bond requirements. New York City's rail-haul plans never progressed beyond the talking stage. Denver rejected rail-haul because cost estimates were not sufficiently firm. In Milwaukee, no community within a feasible distance would provide a garbage repository. A Philadelphia plan is stalled because state officials doubt the sanitary adequacy of using old coal-mining pits as disposal sites.

However, in May, 1970, a monorail system in Cambridge, Massachusetts was scheduled to begin disposal operations. The system will employ a hydraulic compactor developed by a Youngstown, Ohio firm. The monorail will transport the bales of compacted refuse to landfills in western Massachusetts. Estimated disposal charges range from $7 to $8 per ton.

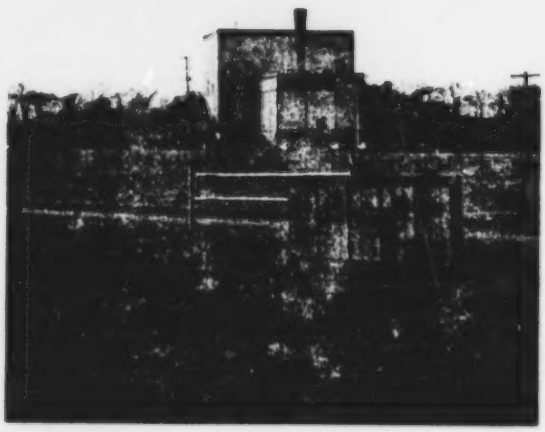
As an alternative to rail transportation, barge transport is being explored in some communities like Cincinnati. Experiments are also underway to explore the possibility of using pipelines and pneumatic tubes to transport refuse in Brooklyn, New York; Orlando, Florida; Sweden; and Great Britain. The results from exploration of such long-distance hauling methods are still too fragmentary to make any general predictions regarding their potential use.

Heat and Electric Power Generation

About a dozen large plants, mostly built since 1964, are burning refuse to generate power in Germany. Two older plants are operating in Switzerland, one in Holland, and one new plant in England. A plant to make steam is now being built in Canada and two are under construction in Japan.

The Norfolk, Virginia, Navy Yard is the only large-scale facility in this country using solid wastes as fuel for steam generation. The steam is piped over the dock sides to power auxiliaries in ships in the yard. A team of New York City officials and Consolidated Edison Company engineers have proposed construction of a large incinerator in Brooklyn which would burn city refuse to produce steam. Combustion Power Co. of Palo Alto, California, is developing a special incinerator that will burn refuse at high pressure, and produce gases that power a turbine which, in turn, will drive an electric generator. This incinerator will be designed to produce about 15,000 kilowatts of electric power daily, while burning 400 tons of refuse. This will supply some 10 per cent of the electric power needs of the area where the refuse is collected.

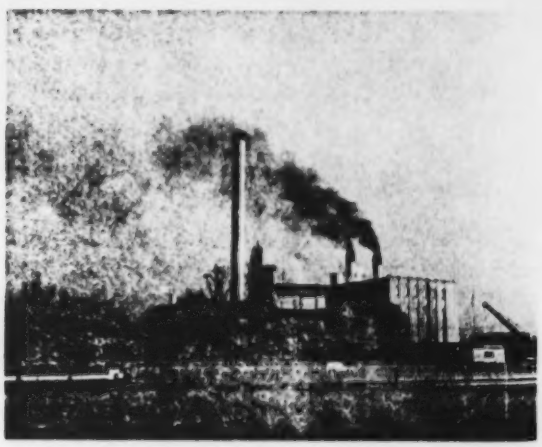
American municipalities have avoided power plants that use refuse for fuel primarily because of high costs and varying B.T.U.[3] values involved. A generating plant that burns refuse costs considerably more than a plant that uses conventional fuels. The items of additional major capital cost include roadways for



Incinerator

3. An eighth of a ton of refuse provides about one million B.T.U. A British thermal unit (B.T.U.) is the quantity of heat required to raise the temperature of one pound of water from 62 degrees F. to 63 degrees F. One B.T.U. equals 252 calories.

multiple boilers rather than one large boiler, the plant's building, a storage pit, cranes, refuse firing grates, residue conveyors, roadways, and truck scales. Labor and operating costs are higher since more men are required, and the European plants are supervised by one or more graduate engineers. With the exception of the multiple boilers, these features and equipment are now used in large incinerator operations.



Municipal electric power plant

However, using refuse to produce electric power appears cheaper than operating an incinerator plant meeting equivalent air quality standards. Richard B. Engdahl of Battelle Memorial Institute, and John D. Hummel of a Columbus, Ohio, firm of engineering consultants, estimated that refuse-burning electric plants when operated in the Midwest would probably cost considerably less than incineration that achieved an equivalent level of pollution control. They considered the dollar values of refuse as fuel (ordinary municipal wastes are said to have a heating value about one-third that of a good grade of coal), the cost to utilize the refuse as fuel, and the cost of disposing of the refuse by alternative means.

In most communities the market for steam heat is limited and fluctuates widely, but there is a steadier demand for electric power. Whether the local power-generating plant is owned by a government or private investors, an electric utility can help in better waste management and in preventing air pollution by participating in a joint incinerator and power generation program.

Grinding

Grinding is commonly used as a method of disposal of food wastes in homes, restaurants, and institutions. A few cities, such as Washington, D.C., also utilize central garbage grinder stations to dispose of garbage. This requires separate collection of garbage and refuse. Since garbage usually constitutes 10 per cent of the total volume of solid wastes collected, grinding garbage into a sewer system takes care of only a minor part of a community's solid wastes. The use of such grinders will affect municipal facilities, such as the sewer system and sewage treatment facilities.

The 1968 Ohio survey of community solid waste practices reported that an average of one out of five households are served by garbage grinders in areas reporting them in use. Use of garbage grinders occurs principally in urban areas and is prohibited in many rural areas of Ohio. The survey also estimated that 2,100 garbage grinders are in use in Ohio commercial and industrial establishments.

A method of grinding rubbish (bottles, cans, packaging, etc.) as well as garbage, known as the Garchey system, has been tried in public housing units in Great Britain. The system works like a kitchen garbage grinder. Waste water washes the rubbish through vertical pipework leading from grinding units in each apartment to a central underground collection chamber. At weekly intervals a collection tank truck pumps the garbage from the chamber. A mechanical ram inside the truck's tank compacts the contents into semisolids and squeezes out most of the water. A truck drain deposits the excess water into the sewer. These semisolids are then delivered to a sanitary landfill.

The Garchey system is limited in what it can process, and its costs may be prohibitive

for some communities. Bulky objects jam the system, and must be dislodged and removed. Installation costs range from $90 to $340 per dwelling unit. Attempts to market the system elsewhere have thus far not been successful.

A similar process known as liquid pulping, however, is being used by hospitals, like St. Anthony Hospital in Columbus. Under this process, a grinding disc with carbide cutting tips rotates within a water slurry, thereby reducing food and other wastes to a fine pulp. Liquid pulping's usefulness is primarily limited to institutions and food-processing establishments.

Volume Reduction Methods

A variety of other processes and equipment to reduce the volume of solid wastes is available or under development. Alternative means of reducing the volume of bulky materials include compaction, grinding, shredding, crushing, hammering, pulverizing, and baling. Special machines are being developed to handle large objects (such as automobiles, refrigerators, and TV sets), to facilitate the transfer of ordinary garbage and refuse, and to compact wastes at sanitary landfill sites.

One leading national department store chain has recently introduced a kitchen compactor unit for sale for household use. The unit will compress rubbish (including cans, bottles, and bones) to about one third its original volume. The unit is sold as a free-standing unit, or may be built into the kitchen cabinet area.

Generally, volume reduction methods that break up solid wastes, such as shredding, grinding, or pulverizing tend to make refuse contents more easily separable and salvable. Methods which bring disparate materials closer together (compaction, crushing) render salvage more difficult, but reduce waste volume and facilitate handling.

Separation and Salvage

According to the U.S. Bureau of Solid Wastes Management, salvage of municipal wastes is carried out on a very minor scale, as an adjunct to other waste disposal operations. The U.S. salvage industry, which includes at least 2,300 major companies with total gross sales exceeding $3 billion a year, is based not upon municipal waste operations but upon commercial and industrial wastes collected in relatively clean and well-segregated form. Municipal wastes are not sought by the salvage industry, because of their mixed contents and their "contaminated" condition. Buyers of secondary materials are becoming more and more concerned with the quality and uniformity of the materials they are buying, because the major cost of salvage lies in collection and separation of the materials. The National Flexible Packaging Association's executive assistant, A. J. Tallat, writes, in correspondence to the author:

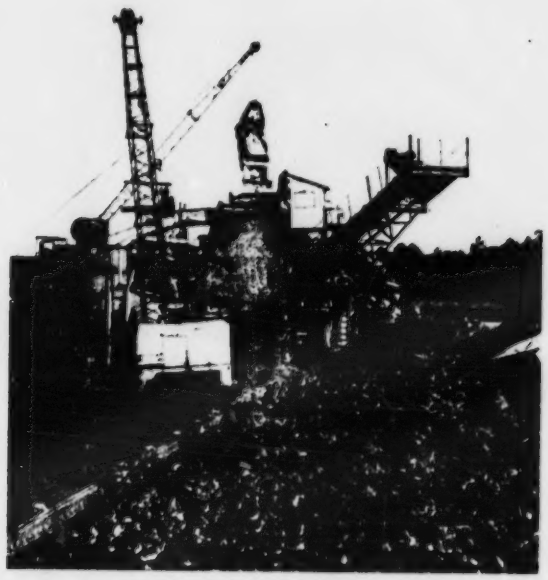
> Re-use of flexible packaging (made of paper, films, and foil) is limited by excessive costs and sanitary, as well as regulatory requirements dictating the use of virgin materials, especially for packaging products intended for human consumption .

Steel, paper, and glass producers are tending to use less and less scrap per ton of product. The Bureau of Solid Wastes attributes this trend in part to changes in production techniques, but also to the fact that reclaimed materials offer little or no price advantage compared with virgin materials, and often involve serious processing difficulties.

Nevertheless, Houston, Chicago, Milwaukee, Madison, and Los Angeles successfully separate, salvage, and sell some materials from solid wastes. St. Petersburg, Florida, has a small but elaborate commercial plant that separates unsorted garbage and trash. Its products do not pay for its operation, but the city makes up the difference between the plant's income and costs by a payment of $3 per ton processed.

Research and development efforts are underway to make salvage economically practicable. The U.S. Bureau of Mines reports that residues from incinerators include as much as 30 per cent metals and 45 per cent glass. The Bureau has awarded a special grant to the American

Major appliance shredder *Jeffrey Manufacturing Co.*



Auto shredder *Jeffrey Manufacturing Co.*

Public Works Association to conduct in-depth studies in six large U.S. cities (including Cincinnati) to determine the most economical ways of recycling such salvageable materials.

Bureau of Mines' studies of incinerator operations near Washington, D.C., Atlanta, and New Orleans estimated the cost of separating the metal and glass in residue, utilizing a plant capable of processing 250 tons a day, to be about $3.50 per ton. The cost includes an expensive hand picking step to remove massive iron fragments. However, a continuous, fully automated system being developed by the Bureau is expected to lower the cost considerably. Chemists at the Bureau of Mines have also developed an experimental method whereby 100 pounds of garbage can be processed to produce two gallons of crude oil.

In South Pasadena, California, the Stanford Research Institute has contracts with the U.S. Public Health Service's Bureau of Solid Waste Management and the Glass Container Manufacturers Institute to conduct experiments on separation of raw refuse for salvage purposes. The institute estimates that the process will cost 50 cents to 70 cents per ton of refuse processed, 40 cents to 60 cents per ton for grinding or shredding the refuse before separation, plus 10 cents for the actual separation step. The estimates include debt servicing and operating costs.

Naturizer Corporation of Norman, Oklahoma, a commercial firm applying a total environmental systems approach to waste management, claims that separation and resale of municipal waste materials is now economically feasible. The company points out that the resale values of various separated waste components are difficult to establish, because only small quantities of such separated materials

are currently available for market analysis. However, it has compiled some value ranges. Other by-products of solid wastes are being developed, according to Naturizer, such as animal feed from composted municipal refuse, and organic gases and charcoal from a composting process. Both show promise of providing additional outlets for waste products, although cost figures are still not available.

Cleveland, Ohio, is experimenting in making bricks from refuse. Dredgings, sewage sludge, fly ash, carbide lime, and garbage have been compressed at 500 pounds per square inch into compact bricks and then submerged in lake water for 30 days. The bricks hardened under water, and did not disintegrate or contribute to pollution of the water.

The goal of most industry-sponsored research in the solid waste field is to make large-scale salvage of materials economically feasible. For example, the Glass Container Manufacturers Institute, Inc. is researching potential reuses for glass in the manufacture of asphalt paving, bricks, insulation materials, and specialty paints. Owens-Illinois has paved two experimental streets in Toledo with "glasphalt," using crushed glass resembling rock candy in asphalt paving. One major aluminum manufacturer recently offered to pay civic groups 10 cents a pound for scrapped cans collected, and a competing aluminum-can producer is offering half a cent for each discarded aluminum can returned. The cans will be melted down and the metal reclaimed. The Glass Container Manufacturers Institute recently offered a penny a pound or a half cent per bottle returned, and will attempt to grind up the bottles to use the ground glass in the manufacture of new bottles. The American Paper Institute reports that recent technological advances in paper chemistry have enabled the construction of new multimillion dollar paper converting plants which have enlarged the market for old newspapers.

Glasphalt paving *Owens-Illinois*

Can salvage from incinerator residue *U.S. Department of the Interior, Bureau of Mines*

Atomic Fusion Torch

Several nuclear physicists say they are now in sight of an elusive goal: control of the same process that fuels the sun—fusion. Development of a machine to control atomic fusion, called an "atomic fusion torch," might by the year 2000 A.D. be used to convert wastes into their basic natural elements for reclamation and reuse.

The sun's immense gravity crushes hydrogen atoms so closely together that pairs of colliding atoms fuse into single atoms of helium. The fusing pairs release the intense energy that heats the sun and sustains the complex nuclear reactions that are necessary to the sun's stability.

For decades, nuclear physicists have envisioned building "miniature suns" of their own. Their dream is to create intense magnetic fields that would compact hydrogen into a small cloud of gas, suspend this cloud in the center of a vacuum chamber, and heat the cloud to temperatures thousands of times hotter than the sun's surface. The intense heat would force the atoms in this "high-temperature plasma" to collide violently and fuse, just as they do in the sun. The magnetic fields would prevent the plasma from touching and vaporizing the walls of the vacuum chamber.[4]

Two of the most important applications of fusion are power production and waste disposal. The energy from a so-called "fusion torch" could be used to generate electric power, and would appear to involve little pollution. Fusion produces little waste heat and involves only small amounts of radioactive materials.

The future waste disposal application has been enthusiastically promoted by two Atomic Energy Commission physicists, Dr. William C. Gough and Dr. Bernard J. Eastlund. As Dr. Gough envisions it, trash, junk, sewage, and other wastes could be fed into the vacuum chamber where they could be vaporized. The stream of superhot gas in the fusion torch would break down the wastes into their basic natural elements like hydrogen and carbon for reclamation and reuse. Drs. Eastlund and Gough envision cities of the future, operated electrically by clean, safe fusion reactors that eliminate the city's waste products and generate the city's raw materials. The hope of applying a fusion torch to solid waste disposal, however, appears decades away.

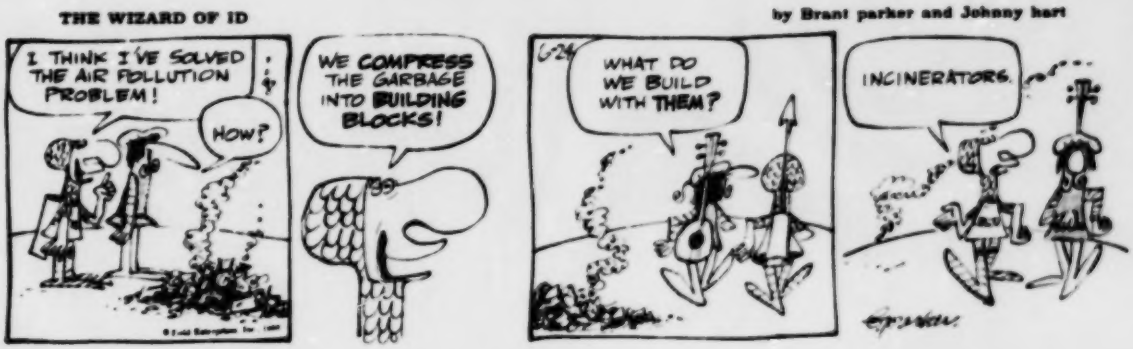
Conclusions

Perhaps this section's most significant conclusion for legislative consideration is that disposal technology is rapidly changing. Substantial improvements in disposal methodology are likely to be developed within a very few years. These improvements will help reduce environmental deterioration, minimize future costs of disposal, and maximize the recovery of reusable materials.

Several implications can be drawn from the current state of flux in which disposal technology lies. First, the prospect that substantially improved methods will be available in the near future tends to weigh against spending for capital equipment beyond current needs. Second, investment primarily in research and demonstration type disposal projects will tend to avoid construction of ordinary type disposal facilities that are soon likely to become technologically antiquated. Third, the likelihood of major technological breakthroughs in a large number of new disposal methods weighs against taking any action at the state level that would tend to lock Ohio communities into a single method of disposal.

4. In 1969, scientists in the Soviet Union successfully demonstrated such a new machine for British observers. The machine, called a Takamak, allows heating of the plasma to 10 million degrees centigrade for one-fiftieth of a second. The Soviet device is approaching the objective of attaining 100 million degrees C. for about a second, which is necessary to achieve a controlled nuclear fusion process that can be applied to generate power and perform other useful functions.

Massachusetts Institute of Technology specialists in fusion-reactor design hope to build a machine similar to the Russian Takamak, using a more powerful magnet, that will reach the goal. The MIT group hopes to have their device operating by the summer of 1971. Meanwhile, research groups at Princeton Plasma Physics Laboratory, Oak Ridge National Laboratory, California's Lawrence Radiation Laboratory, the University of Texas, the University of Wisconsin, and Gulf General Atomic Corporation, are exploring a variety of ideas for practical applications of such devices.


THE WIZARD OF ID
by Brant parker and Johnny hart
I THINK I'VE SOLVED THE AIR POLLUTION PROBLEM!
HOW?
WE COMPRESS THE GARBAGE INTO BUILDING BLOCKS!
WHAT DO WE BUILD WITH THEM?
INCINERATORS.

By permission of Johnny Hart and Field Enterprises, Inc.

A few experts on solid waste disposal have speculated about what future disposal methods will be successful. For example, John H. Abrahams, Jr., manager of environmental pollution control programs at the Glass Container Manufacturers Institute, has presented the following ideas for "an ideal waste disposal system" of the future.

> My own idea of an ideal waste disposal system for a community is based on two premises: first, that the ultimate solution lies in a combination rather than a single approach to the problem; second, that salvage, reuse, and recycling are fundamental to a successful solution.
>
> Obviously, the closer to the consumer that a salvage operation can start, the more efficient it will be. Ideally glass, metal, paper and other such materials would be segregated initially in homes, hotels, shopping centers, and other establishments that are major waste producers. Of course, resistance to such on-the-spot salvage schemes has been great. If it remains so, there should then be a system of regional distribution stations to which wastes would be transported by conventional garbage trucks until other means of transfer are developed.
>
> These stations would be designed to separate the refuse instead of compacting or baling it as is done today. Paper, rags and similar material would be separated, baled and shipped to appropriate mills for reuse. The glass would be returned to manufacturers, and the scrap metals would be sent to the melting furnaces of steel mills, foundries, and refineries to help make new products. Garbage and vegetable waste material would be composted.
>
> Systems of this type are being developed now and several pilot plants are operating and soon should be ready for field testing.
>
> For additional benefits, sludge and agricultural wastes could be mixed with the compost to increase its fertilizer value and possibly be spread on public lands.
>
> In other words, everything would be used and used again, leaving only a small fraction of material to actually be "thrown away"—and much of that being returned to the land in some beneficial manner.[5]

In summary, Abrahams sees future disposal systems as employing a variety of methods in combination, with more and more materials being separated and salvaged, while remaining materials are hauled greater distances, processed to reduce their volume, and then landfilled. He implies that some separation of salvageable materials from household and office wastes may have to be done by housewives and office workers.

Ohio communities may have a great stake in their application of future disposal technology. Whether Ohio communities will continue to be healthful and enjoyable places to live may depend upon how Ohio cities and industries dispose of their wastes in the future.

Jane Jacobs, a well known author and commentator on urban problems, imagines how future cities and industries will continuously "mine" and recycle their own wastes, in her most recent book, *The Economy of Cities*:

5. "Wealth Out of Wastes" by John H. Abrahams, Jr. in *Nation's Cities*, September, 1969, pp. 20-22.

> . . . in the highly developed economies of the future, it is probable that cities will become huge, rich diverse mines of raw materials. These mines will differ from any now to be found because they will become richer the more and longer they are exploited. The law of diminishing returns applies to other mining operations. The richest veins, having been worked out, are gone forever. But in cities, the same materials will be retrieved over and over again. New veins, formerly overlooked, will be continually opened. And just as our present wastes contain ingredients formerly lacking, so will the wastes of the advanced economies of the future yield up ingredients we do not now have. The largest, most prosperous cities will be the richest, the most easily worked, and the most inexhaustible mines. Cities that take the lead in reclaiming their own wastes will have high rates of related development work; that is, many local firms will manufacture the necessary gathering and processing equipment and will export it to other cities and to towns.[6]

Mrs. Jacobs suggests that significant economic benefits may be derived from cities and states reusing and recycling materials disposed of within their boundaries, and that cities which act to reclaim wastes will provide employment opportunities for people who will gather and process waste materials, and transport its products to other places.

6. Jane Jacobs, *The Economy of Cities* (Random House, 1969), pp. 110-111.

Glass used in glasphalt *Owens-Illinois*

Chapter III

GOVERNMENT PROGRAMS

Present state involvement in programs relating to solid waste disposal consists primarily of three activities: (1) regulation of community disposal practices, (2) provision of technical assistance and limited financial assistance, and (3) adoption of legislation enabling communities to perform disposal services. Federal programs are largely limited to support of planning, research, and demonstration projects.

Earlier chapters noted that serious public concern with the effects of solid waste on environment and health is a relatively recent phenonenon, and that responsibility for disposal of solid waste has been exercised primarily by local governments and private enterprise. Since state and federal involvement in solid waste disposal has been slight, relatively few laws and regulations pertaining to it exist at present. Consideration is now being given in Congress and in several states, including Ohio, to imposing charges and restrictions on the use of nonreturnable containers and other products that create disposal difficulties, and to other measures designed to reduce the production of solid wastes or facilitate their collection and disposal. However, legislation and regulations remain limited.

THE STATE ROLE

Regulation

Ohio's state-level approaches to improvement of solid waste disposal have been primarily through regulations and laws enacted since 1967. The Solid Waste Disposal Law and Ohio Public Health Council regulations stress inspection, licensing of local solid waste disposal facilities, and review of plans for their construction.

Regulation involves specifying which methods of solid waste disposal are lawful or unlawful, and prescribing the actual procedures for disposing of wastes and the physical conditions for employing such procedures. The regulatory method has been the principal approach toward improving disposal practices up to the present. For example, open burning and open dumping are prohibited by Ohio law, subject to a fine of $100 per day for violation. Ohio law also requires a license to operate a sanitary landfill (or disposal facility employing any other disposal method permitted by rule of the Public Health Council), and requires the operator to possess and use the equipment and daily operating procedures prescribed by Public Health Council rules. (Wastes must be covered daily with earth or other suitable cover).

Prior to 1967, the regulation of solid waste disposal sites was left to counties and municipal corporations. No coordinated effort was made to regulate disposal practices throughout a wide area. One method of controlling flagrant abuses was to invoke nuisance abatement measures in court. Since this method was cumbersome, it was attempted infrequently. Some municipal corporations attempted to control disposal operations under local air and water pollution ordinances; but these ordinances could be enforced only after a violation had occurred. Municipalities' jurisdiction ends at their geographic boundaries. Where one municipality attempted to control disposal activities, the absence of efforts by neighboring communities left gaps in control. Counties were authorized by law to adopt sanitary regulations governing garbage and refuse disposal, but few did so prior to 1967.[1]

In 1967, the General Assembly enacted Am.

1. Chapter 343. of the Revised Code.

Sub. H. B. 623, which was designed primarily to upgrade landfills and incinerator activities, and to eliminate open dumping and open burning. Basically, this law involves review of the plans for all new disposal facilities, and state supervision of the enforcement of Public Health Council operating regulations.[2] It includes a statutory ban on open dumping and burning, except as permitted by such regulations, and directs the Public Health Council to adopt uniform regulations, applicable throughout Ohio, to:

> . . . assure that all solid waste disposal sites and facilities will be located, maintained and operated in a sanitary manner so as not to create a nuisance, cause or contribute to water pollution, or create a health hazard.

The Council has adopted its regulations, which became effective on July 1, 1968.[3]

Review of plans for new facilities and conversions. Under the regulations, Department of Health approval of plans must be obtained for any new solid waste disposal sites and facilities, and for dumps being converted to sanitary landfills. Detailed plans must be submitted to the Solid Waste Section in the Engineering Division of the Ohio Department of Health, which both reviews the plans and makes a site investigation of each facility. The Section staff includes three engineers and one sanitarian, who with five field engineers in the department's district offices reviewed some 55 sets of plans and specifications and personally inspected the sites during 1969. Sanitary landfill sites are inspected for potential pollution of ground and surface waters. The plans and sites are examined to determine the adequacy of procedures for unloading, spreading, and compacting wastes, and for covering them with earth, the availability of suitable equipment, and other considerations in the interest of public health. Incinerator plans must indicate air pollution control features and how incinerator residues will be disposed. Site investigations and plan review are also required for composting operations and any new disposal methods.

Enforcement of operating requirements. Licensing of all solid waste disposal sites and facilities is now required by law. The licenses are issued by local boards of health for a fee which each board may determine, but which may not exceed $500 a year. The boards of health are responsible for periodic inspection of solid waste disposal sites and facilities. A board of health may immediately suspend, revoke, or deny a license to avert a serious public health hazard. In the absence of such a hazard, licenses may be suspended, revoked, or denied only after formal notice is given in writing to the operator and a "reasonable" time to make corrective measures is allowed. Upon complaint by the local board of health or the state Public Health Director, the city solicitor or the county prosecuting attorney must file suit to enjoin violators and seek any other legal remedies available and appropriate (criminal charges or damages). The criminal penalty for each violation of the solid waste disposal law may not exceed $100 per day.

The solid waste disposal law (Chapter 3734. of the Ohio Revised Code) requires the Department of Health to survey local licensing programs annually to assure compliance with and uniform application of the law throughout Ohio. To perform this function a second Solid Waste Unit was established, this one in the Sanitation Division of the Department of Health. This unit, staffed with one sanitarian in the main Columbus office and five sanitarians in the district offices, is responsible for the administration and enforcement of the day-to-day operating requirements for landfills and incinerators. Virtually all of the 650 or more disposal sites licensed during 1969, scattered among the 115 local health departments having disposal sites or facilities, were personally inspected at least once during the year. Departmental officials claimed that prior to July, 1968, fewer than five per cent of the facilities met the standards adopted. Some 400 facilities have been closed; virtually all of the others are cooperating with local health departments in improving disposal

2. Chapter 3734. of the Revised Code.
3. Regulations HE-24-01 to HE-24-12, inclusive.

practices. In 1970 nearly all of the remaining 450-odd sites were inspected.

Problems in Enforcement of Regulations

Experience with Ohio's regulatory efforts since 1967 suggests four enforcement problems: (1) lack of continued surveillance to insure compliance, (2) omission of significant types of activities from regulations, (3) procedural loopholes for avoiding compliance, and (4) lack of authority for health inspectors to obtain search warrants.

Continued surveillance. Despite the law's sweeping prohibition against open dumping and open burning (except in accordance with Public Health Council regulations), these practices continue to occur and have been observed by the LSC study staff. They are difficult to prevent, and in the absence of constant surveillance, compliance is essentially voluntary. Enforcement measures must be taken after violations, if detected, have already occurred. The licensing law did not provide any means for increasing local health department staffs. Thus enforcement primarily depends heavily upon citizen complaints to local health departments.

Closer surveillance might be provided by enlarging the state's enforcement staff, augmenting local health department staffs, perhaps with a state subsidy, or by giving citizens statutory authority to file suits to enjoin violators. The former approaches would require more money to pay enforcement staff. On the other hand, leaving enforcement to citizens generally might result in uneven enforcement, ranging from a rash of law suits in areas where the public is alert to disposal abuses, to total inaction where people are indifferent.

Exempted facilities. The Public Health Council regulations exempted several types of waste handling facilities which create hazardous conditions. Chapter 3734. of the Revised Code, defines solid wastes as:

> . . . such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, excluding earth or materials from construction, mining, or demolition operations and slag and other substances which are not harmful or inimical to public health, and includes garbage, combustible and noncombustible material, street dirt, and debris.

Public Health Council regulation HE-24-01, paragraph (L) further defines "site" as:

> . . . any location, place, or tract of land used for stabilization, conversion, utilization, incineration, or burial of solid wastes other than those solid wastes produced on the premises.

While "solid wastes" include virtually any substance found at a community disposal site, several types of facilities or activities are not required to be licensed:

1. Industrial plants and commercial establishments which dispose of their own wastes on their premises.
2. Scrap processors, junkyards, and salvage industries.
3. Building demolition operations.
4. Mining operations.
5. Construction activities.
6. Farm wastes: livestock manures, soils, fertilizers, pesticides, prunings, crop harvesting residues, and animal carcasses.[4]

Health department officials in Ohio's largest cities regard the third category, the burning of building rubble by building demolition contractors, as the most difficult practice to control, and the most serious health hazard, among the categories not required to be licensed.

Exempted activities could be controlled by: extending present licensing to cover them, imposing a permit system on all disposal operations, or imposing criminal penalties for hazardous practices and environmental damages. The licensing requirement could be extended to in-

4. Whether or not agricultural or farm wastes are subject to the existing law and regulations is indeed ambiguous and perplexing. Literally, the law includes "unwanted" materials from "agricultural" operations, but the regulation quoted above exempts wastes produced on the premises. Presumably, manure produced in "unwanted" or unusable quantities are exempted if they are produced on the farm premises. In practice, local health departments do not license farms as disposal facilities. The law does not appear to be designed to deal effectively with farm or feedlot wastes.

Scrap automobiles along highway

Industrial activities

dustrial and commercial establishments, scrap and salvage operations, and farm wastes by administrative change of the Public Health Council regulation, and to demolition, mining, and construction activities by legislation. Extension of licensing to include all six categories would impose a major additional enforcement workload. Monitoring back yard, apartment house, and shopping center incinerators would impose a difficult task of licensing and enforcement. In fact, the effectiveness of merely licensing industrial plants, commercial firms, etc., to dispose of their own wastes, without employing a staff to monitor their operations continuously, may be questioned.

The second approach—that of requiring all persons including commercial and industrial firms who dispose of solid wastes in any appreciable quantity to obtain a permit from a designated enforcement agency such as the Health Department, similar to an oil drilling permit or a permit from the Water Pollution Control Board to discharge effluent into an Ohio stream—would also require a large number of enforcement personnel to monitor compliance, both at the local and state levels. Industrial firms are already required to obtain permits from the Ohio Department of Health to dispose of "industrial wastes" (defined as "water-carried or liquid wastes") resulting from any industrial or business process (sections 3701.19 and 3701.59 of the Revised Code). Further, the Department of Health is charged with supervision of industrial wastes and, for this purpose, may issue orders and regulations requiring firms to report disposal plans and information, prescribe methods of disposal, and govern the operation and maintenance of planned and existing disposal facilities and processes (section 3701.20). These old permit laws (they date back to 1905 and 1925) were designed primarily to protect public water supplies.

The third approach—that of applying criminal penalties to anyone who violates disposal requirements—is not necessarily exclusive of the preceding two. Unsanitary disposal practices, or practices which annoy and interfere with neighbors' use and enjoyment of their property could be made criminal offenses, punishable by fines, damages, and imprisonment. This approach would enable law enforcement officers and individual persons generally to stop disposal abuses. As an inducement to bring actions against violators, the persons seeking actions could be authorized reimbursement for their legal expenses, and awarded double or triple damages or large statutory fines for violations.

Procedural loopholes. The existing law authorizes political subdivisions to have a hearing before the local board of health may suspend,

revoke, or deny their licenses. The board of health is required to consider the financial condition of the political subdivision, and may grant a conditional license despite the subdivision's failure to comply with the regulations. This procedure delays the closure of sloppy, marginal operations, and makes it difficult for health departments to terminate such operations. Most of the facilities with which the Sanitation Division of the Department of Health reports difficulty in obtaining compliance are operated by rural townships and villages, which may not have the financial means to comply with regulations.

In one or two cases, county prosecutors have refused to take legal action to enjoin townships from violating disposal regulations by closing their dumps. This problem, whereby a local official nullifies the effect of a state law by refusing to prosecute, could be remedied by amending the law to require the Attorney General to prosecute upon request of the Ohio Director of Health.

Inspection warrant. Health inspectors enforcing the solid waste disposal law lack authority to obtain a warrant to inspect property where they have been refused entry. The problem arose from 1967 opinions by the United States Supreme Court in *Camara v. San Francisco*, 387 U.S. 523, and *See v. Seattle*, 387 U.S. 541, that warrants must be obtained to inspect private property for fire, health, and housing code compliance where entry has been refused, unless a citizen complaint or some other satisfactory reason exists for securing immediate entry. Roughly 25 per cent of all disposal facilities in Ohio are privately owned and operated. Denial of access to licensed private facilities might be prevented by specifying that advance permission for entry for inspection purposes be a condition for obtaining a license or permit.

Financial and Technical Assistance

State financial help for the construction of solid waste disposal facilities is nominal, but technical assistance is provided in the form of surveys, consulting services, and training.

Financial aid. The General Assembly recently authorized nominal financial aid, that will primarily benefit affluent communities. S. B. 447, enacted in 1970, authorized the Ohio Water Development Authority to issue revenue bonds to aid construction of solid waste disposal facilities. The primary purpose of S. B. 447 was to help make construction of disposal facilities possible where financial impediments exist, by allowing several industries and political subdivisions to contract with the Ohio Water Development Authority for construction of a joint disposal facility. Bonds would be marketed when an individual industry or municipality could not obtain financing. State financial aid consists exclusively of revenue bond assistance, which in effect saves a community perhaps one per cent of the total amount it borrows to finance disposal facilities, and the community must pay back all of the principal it borrows plus interest.

Ohio's needs for new and improved disposal facilities over the next five years will cost on the order of $60,000,000. Yet, state revenue bond financing helps communities only to the extent that state bonds help obtain interest rates lower than communities themselves can obtain.

Further, revenue bond financing is applicable only to communities with relatively high per capita income. Advocates of revenue bond financing argue that disposal facilities lend themselves to operation on a service charge basis, and can be made sufficiently revenue-producing to cover operating, maintenance, and debt service costs simply by raising service charges to necessary levels. In Ohio, service charges are billed to householders in virtually all communities where private haulers or contract haulers provide refuse collection services. These are primarily suburban communities. A 1967 Ohio Municipal League survey indicated that of 405 reporting municipalities, 218 use private haulers, 66 contract for refuse collection service, and 140 provide municipal collection. (Since some municipalities use more than one method the total methods reported exceeds 405.)

On the other hand, Ohio's 13 largest cities provide municipal refuse collection service without charge to householders. Placing greater dependence on revenue bonds for disposal facilities, therefore, would require inhabitants of Ohio's large cities to bear disposal costs directly through user charges. This would result in the cost being borne often by those least able to pay, since U.S. census data illustrate that the largest numbers of persons living in poverty in Ohio are located in the eight largest cities.[5] Likewise, revenue bond financing and user charges would have limited effectiveness in the relatively poor Appalachian counties of southeastern Ohio.

Technical assistance. Three forms of technical services on solid waste disposal are provided by the Ohio Department of Health: surveys, training, and consulting services. Since 1966 the U.S. Public Health Service's Bureau of Solid Waste Management has awarded Ohio some $200,000 for a statewide survey of disposal practices, problems, and needs in Ohio. The state's investment in the survey consists of staff time approximately equal in value to the total dollar amount of Federal grants over the four-year period. The survey results have not been published, but were made available to the LSC study staff for the preparation of this report, and are used in the department's consulting and training services to local health departments and agencies responsible for operating disposal facilities.

Formal training for local health inspectors and key disposal facility operating personnel is arranged by the Sanitation Unit of the Health Department's Sanitation Division. During the past year 128 key operating personnel attended one of fifteen 3-hour training sessions held at regional locations throughout Ohio. Part of each session was held at a landfill site and part was classroom-type training. Department sanitarians believe it would be useful if this type of training were provided to all the key operating personnel at all of the licensed sites, or to some 600 persons, at least once a year. The sanitarian-in-charge believes that the staff workload for providing this training could probably be absorbed. The Sanitation Unit has arranged 25 full-day meetings at regional locations where local health department responsible for inspecting disposal facility operations were briefed on the disposal law, regulations, and operations. This training reached some 350 persons, each who attended two full-day briefing sessions. The sanitarian-in-charge plans to continue scheduling such formal training sessions from time to time as the Public Health Council's regulations are modified and problems occur. The unit also sponsors a three-day seminar on solid wastes for 30 select inspection personnel from local health departments annually at Ohio State University.

State Health department solid waste disposal personnel claim that extensive informal training occurs during routine on-site inspections and informal consultation. The five district-office sanitarians annually inspect all the disposal facilities licensed by each of the 112 local health departments having facilities. The local inspector accompanies the state sanitarian during the inspection, and they exchange information. In addition, the three engineers and one sanitarian assigned to the Engineering Division's Solid Waste Section and the five district office engineers are available for consultation and information, upon local request.

Local Government Powers Concerning Solid Waste Disposal

Ohio's Constitution and enabling laws give local governments extensive powers to conduct garbage and refuse collection and disposal services, as well as considerable flexibility in the financing of solid waste handling facilities and cooperation in disposal operations. Despite the availability of permissive legislation enabling regional disposal efforts, few such efforts have been taken.

Disposal services are most commonly provided in Ohio by municipalities and counties, or by private disposal facility operators. State laws enable municipalities and counties to collect, store, transport, process, and dispose of

5. *Programs Affecting the Urban Poor*, Ohio Legislative Service Commission Information Bulletin 1969-2, Columbus: June, 1969, pp. 1-2.

all types of solid wastes.[6] County commissioners and municipal legislative authorities may adopt regulations governing the handling of solid wastes as long as county regulations are consistent with state health regulations, and municipal regulations do not permit conditions or activities prohibited by state law. Both may abate nuisances caused by the improper handling of solid wastes, have their sanitary or public service department perform necessary waste disposal services, or contract with other governments or private businesses for the services. Municipalities and counties may contract to furnish disposal services to school districts, townships, and other governmental units.

Wide flexibility in the financing of disposal services is permitted both municipalities and counties. Both may levy and collect service charges and taxes to finance collection and disposal, issue liens against property for delinquent taxes or charges, issue general obligation or revenue bonds, refund bonds for lower interest rates, recall bonds for fewer interest payments, and accept grants in aid. Service charges may be collected for disposal services provided to public agencies and tax-exempt organizations, as well as individuals and businesses. Bonds issued to finance disposal facilities are exempted from municipal and county debt limits to the extent that income from the facilities is sufficient to cover operating expenses, interest charges, and debt retirement costs.[7]

A county may establish one or more garbage and refuse collection and disposal districts within its boundaries.[8] In other words, the county commissioners may provide disposal services in all unincorporated territory in the county, or they may create one or more districts and tax or charge residents for services within such districts. A municipality may be included in a district upon approval by its legislative authority.

Counties lack specific authority to appropriate property for disposal facilities. Municipalities may, if necessary, take property for disposal facilities by eminent domain.[9] Counties may acquire sites for disposal facilities only by purchase, lease, or gift. There appears to be no special reason why counties do not have authority to use the power of eminent domain to acquire disposal facility sites. Some officials view the absence of such authority to be harmful, especially when other methods fail, a likely possibility because of public sensitivity over landfill site selection.

Townships have more limited powers to handle solid waste disposal; still, they may contract with a county or municipality or with a private contractor to obtain refuse collection and disposal services.[10] Townships may provide disposal sites, operate a refuse collection and disposal system, create waste disposal districts, and levy taxes and collect user charges within the districts. However, they have no authority to issue bonds or borrow in order to finance disposal facilities. Few, if any townships have sufficient ability to pay the costs of a proper disposal operation, nor do they serve a large enough population to make economically efficient the use of the jurisdiction in disposal responsibilities.

Ohio law attempts to facilitate regional cooperation and joint handling of solid waste disposal operations through intergovernmental contracts, councils of governments, and regional planning. Several counties may join in the establishment of an areawide garbage and refuse collection and disposal district, and contract with one another or with a municipality or private business for necessary services.[11] Regional councils of governments are also authorized to perform waste disposal services for member governments under contracts, at the option of member governments.[12] Regional planning commissions are empowered to per-

6. Municipal powers regarding solid waste disposal are found in sections 715.43, 715.44, 307.14-19, and 3707.39-46, or may be assumed under the grant of "all powers of local self-government" and "such local police, sanitary, and similar regulations as are not in conflict with general laws" in section 3 of Article XVIII of the Ohio Constitution. County powers regarding disposal are found in Chapter 343., and section 6115.04.

7. Sections 133.03 (D) and 133.06 of the Revised Code.

8. Chapter 343.

9. Division (J) of section 719.01.

10. Sections 505.27 to 505.33.

11. Section 307.15 and Chapter 343.

12. Sections 167.03 and 167.08.

form functional planning for solid waste disposal systems, and undertake comprehensive environmental planning for member governments.[13]

Little joint action has occurred, however. No counties have established any multi-county disposal districts. Only 38 county disposal districts have officially been established. Of these, only nine are actively operating sanitary landfills, one (Miami) has an operating incinerator, and one (Montgomery) has two incinerators. Twenty-seven county disposal districts are not actively operating while they await financing, engineering studies, or site selection. In addition, two counties (Huron and Fulton) operate county-wide disposal sites but have not officially established disposal districts.

Most of the activity by planning commissions and councils of government is at the study or planning stage. Only a very few regional or county planning commissions have prepared or are preparing waste disposal systems studies. Of a total of 59 regional or county planning commissions and 12 councils of governments, only five have completed solid waste disposal studies, five have studies underway, and three have proposed solid waste studies. The Ohio-Kentucky-Indiana Regional Planning Commission is developing a plan for solid waste disposal for an area embracing several counties in each of the three states. So also is the Miami Valley Regional Planning Commission, which embraces several counties in the upper reaches of the Miami Valley. The City Planning Commission of Akron completed a comprehensive regional waste disposal study in 1968.

In summary, adequate legal tools exist to enable local governments to improve their solid waste disposal services (with the exception that counties lack authority to acquire disposal facility sites by eminent domain). But the relative lack of local government action on solid waste disposal, coupled with the growing volume and complexity of disposal problems, suggests a need for state action or state encouragement of further action by local governments.

13. Section 713.23.

THE FEDERAL ROLE

Federal programs in solid waste disposal currently emphasize planning, research, and demonstration projects, and provide only limited assistance for solid waste disposal facilities.

Several present and proposed federal programs have an actual or potential impact on improving solid waste disposal, although existing assistance for solid waste projects is very limited. One federal practice designed to encourage regional approaches to solid waste handling is that of requiring the review of applications for federal grants in aid for solid waste projects, by an areawide planning agency or council of governments.

The federal Solid Waste Disposal Act of 1965 is intended to encourage regional disposal systems through state and regional planning. The act provides financial assistance through the U.S. Bureau of Solid Waste Management in the Department of Health, Education, and Welfare for: (1) planning grants to state or interstate agencies to develop solid waste disposal plans within their jurisdictional areas, including surveys of area disposal practices and problems (for example, the present Ohio Department of Health survey); (2) survey grants to study particular waste handling problems, practices, or techniques of significant national interest; (3) research grants to develop new, improved, and economical methods of collection, storage, treatment, utilization, reduction, processing, or final disposal; (4) demonstration grants to develop and apply new and improved solid waste handling methods, devices, or techniques; and (5) training grants, providing equipment, supplies, tuitions and stipends for graduate level instruction in the general field. In order that a disposal project will help meet present and future needs of the region, HEW requires that current housing projects, water and sewer plans, highway and transportation plans, and related urban land use plans be considered by the community, before a grant is awarded.

Research and demonstration activities under the act are conducted primarily by the U.S. Bureau of Solid Waste Management's National

Center for Urban and Industrial Health, located in Cincinnati. The bureau also provides technical assistance on solid waste management and one week training courses that focus on new and improved disposal methods. The act also directs the U.S. Department of the Interior to study waste disposal problems stemming from the extraction, processing, or use of minerals or fossil fuels.

Federal funds for the construction of solid waste treatment facilities have thus far been limited to research and demonstration-type projects. In fiscal year 1969, only $10 million for solid waste disposal grants was spread among 59 research, 51 demonstration, 41 planning, and 11 training projects throughout the U.S. Ohio has received some $200,000 in planning grant moneys during the past four years. During fiscal years 1969 and 1970 only three Ohio communities received federal demonstration grants; Cleveland—$100,000 for compacting refuse into bricks that can be used to reclaim submerged land; Franklin (a small community northeast of Middletown)—$1,216,692 for a unique system for separation, salvage, and disposal of urban and pulp industry wastes; and Montgomery County—$45,000 for a computerized management information system for incinerator operation. During fiscal years 1969 and 1970 only one research grant was awarded in Ohio, for $249,726 over the two years to Battelle Memorial Institute for research on fireside metal wasteage in municipal incinerators. No training or planning grants for local governments have been awarded in Ohio.

The level of federal funds does not meet the U.S. Public Health Service's estimates of community disposal facility needs across the nation. The U.S. Bureau of Solid Waste Management estimates a total of some $215 million is needed for capital facilities nationally each year over a five year period, including $45 million a year for incinerator improvements alone. The Nixon administration requested about the same level of assistance for fiscal year 1971 as was provided in fiscal year 1969—some $10 million for disposal grants.

Senator Edmund S. Muskie and other Congressional leaders have proposed more comprehensive levels of federal assistance for construction of disposal facilities. Hearings were held in October, 1969, by the U.S. Senate Public Works Subcommittee on Air and Water Pollution, on S. 2005, Senator Muskie's proposed Resource Recovery Act, which in its original form would have authorized some $833 million in federal funds over a five-year period for construction of solid waste treatment facilities. At Senate hearings, former Secretary of Health Education and Welfare Robert H. Finch opposed a program of federal grants for construction of solid waste facilities, because they would place the financial burden on the individual taxpayer. He favored incentives to industries producing a large volume of solid wastes to encourage them to eliminate, reduce, or reclaim their wastes. Secretary Finch also opposed the grants for categorical planning of regional solid waste disposal systems called for in S. 2005, stating that planning for disposal facilities should be conducted as part of a comprehensive environmental planning effort. The deputy director of the Office of Science and Technology, Hubert Heffner, also opposed the categorical planning grants because he felt they would dictate expenditure priorities for communities.

Both the Senate Committee on Public Works and the House Committee on Interstate and Foreign Commerce, which heard the House companion bill, HR 11833, removed the construction-grant provision and limited federal aid to higher levels of demonstration grants, particularly emphasizing resource recovery systems for community wastes—separation, salvage, and recycling methods. On October 26, 1970, President Nixon signed the Resource Recovery Act of 1970 (Public Law 91-512). In its final form the act authorized $41.5 million for construction grants demonstrating new and improved techniques and for administering HEW's solid waste programs in fiscal year 1971, plus a total of $220 million for demonstration-type construction grants during fiscal years 1972 and 1973.

During the next few years it appears likely that Congress will await the results of current research and demonstration projects before

authorizing federal subsidies for disposal facilities employing current technological methods. This cautious approach is expressed in the report on S. 2005 by the United States Senate Committee on Public Works:

> The Committee carefully evaluated the desirability of legislation to provide direct financial assistance to communities to construct solid waste disposal facilities. This provision, included in S. 2005 as originally introduced, was rejected for three reasons: (1) construction grants at this time could lock in existing conventional technology, (2) even clean incinerators and sanitary landfills would not conserve resources, and (3) a large Federal grant authorization program at this time might retard present community efforts unless appropriations kept pace with authorizations, which is not likely.
>
> The Committee believes that future Federal financial assistance to communities for construction of facilities may be necessary. Demonstration systems developed pursuant to this act will provide guidance as to what kinds of construction should be assisted, what recovery techniques will be most economical, and what collection innovations will most effectively reduce the cost of waste handling.[14]

Regardless of how much or what types of assistance Congress authorized in 1970, many Ohio communities will have to face investment decisions for many years ahead. In each case the community will have to decide whether to invest in new disposal equipment immediately when the needs arise, or when further advancements are achieved in disposal technology.

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14. Senate Report No. 91-1034, pp. 2-3. See also House Report No. 91-1155 and the Conference Report (House Report No. 91-1579) for statements of members of the House of Representatives.

Chapter IV

ORGANIZATION TO MAKE EXISTING WASTE DISPOSAL METHODS MORE EFFECTIVE

Improved solid waste disposal operations might be achieved if they could be directed by one or more authorities relatively removed from local governmental disputes.

The preceding parts of this report have stressed the nature of the solid waste disposal problem, existing and potentially useful disposal methods, and Ohio's present laws affecting solid waste. This chapter considers means by which solid waste disposal methods could be improved through restructuring of governmental organization of disposal services.

Currently, responsibility for solid waste disposal in Ohio lies chiefly with local governments, which understandably tend to concentrate on meeting their own communities' needs. This frequently results in disposal operations that are too small to be efficient, or that may neglect collection and disposal of wastes produced at sites near a community's boundaries but outside its jurisdiction. Several factors suggest that regional approaches to solid waste disposal may result in more satisfactory and economical disposal.

Three of these factors are discussed below. The first is that regional authorities are more likely to include in their service areas places where wastes accumulate but are not removed by local governments. Secondly, regional approaches can achieve efficiency and economy through what economists call "economies of scale." Finally, a regional approach would overcome some problems growing out of the "fragmentation" of existing governmental approaches to solid waste disposal. The closing part of this chapter reviews arguments advanced by some proponents of regional solid waste disposal organization.

Comprehensiveness of Services

Regionalization of governmental organization for solid waste disposal increases the likelihood that all significant disposal problems in a region will be met, and lessens opportunities for waste producers to evade regulation by locating facilities outside a governmental jurisdiction's boundaries.

A major shortcoming of existing disposal operations stems from communities' tendencies to overlook industrial plant wastes and other waste sources in designing disposal facilities and in planning for waste collection and disposal services. The U.S. Public Health Service's 1968 National Survey of Community Solid Waste Practices, and a recent study by Dr. Rolf Eliassen, a Stanford University consultant to the U. S. Office of Science and Technology in the Executive Office of the President,[1] found that most major cities overlook the types and quantities of wastes of nearby industries, federal installations, and other waste sources, in planning city disposal facilities. Overlooked wastes may result in deterioration of a community's environment, even though the source of the wastes is located outside the city's boundaries.

Several national surveys, including the two cited above, indicate that better approaches to disposal of community wastes are likely to be obtained from considering types of wastes not ordinarily handled by local government disposal facilities, and by designing facilities to

1. The Eliassen Report is reprinted in the Hearings before the Subcommittee on Air and Water Pollution, U.S. Senate Committee on Public Works, *Resource Recovery Act of 1969*, Washington, D.C., Part 2, pp. 692-812.

handle all the wastes generated in an area. All types and quantities of wastes generated in a community must be considered in designing facilities capable of meeting a community's total disposal needs. Organization of disposal facilities on a regional basis would provide a unified service area enabling comprehensive collection and disposal of domestic, municipal, commercial, industrial, agricultural, animal, and mineral wastes.

Economies of Scale

Regional organization of solid waste disposal services can yield economical operations by permitting large-scale approaches to disposal problems.

The concept of "economies of scale" simply is: as scales of operation increase, additional costs of units added to the operation will decrease. This report noted in Chapter II that substantial savings in initial capital costs of incineration may be realized by having an incinerator serve a population of 500,000 rather than 25,000. Incinerator operation approaches maximum efficiency (lowest cost per ton of refuse processed) when operating near full capacity. An incinerator plant that serves an area and population large enough to sustain a round-the-clock operation will achieve the lowest unit cost of processing wastes.

A study group from Massachusetts Institute of Technology found that communities disposing of 200 tons a day have difficulty in keeping the real cost of disposal at $10 per ton or less. The M.I.T. group strongly recommends that any community handling less than 1000 tons per day or, in terms of population, all communities with fewer than 40,000 inhabitants, join with nearby communities to form a more economical area. They found that several types of facilities that handle 2000 tons a day are capable of bringing costs to below $5 per ton after collection and delivery to the disposal sites. The M.I.T. group and Ohio solid waste officials claim cost advantages for large-scale landfill as well as for incineration. The economies of scale associated with the operation of a landfill are related to the expenses necessary for heavy equipment and for the salaries of personnel to operate such equipment. Equipment and salary costs for a small landfill may be as expensive as those necessary for a large landfill. The M.I.T. study reported:

> . . . the whole field of waste collection and disposal is predominantly in the hands of small, marginally viable, contractors with very few trucks, poor management, and no engineering. The maintenance of a high quality environment is not something to which these small businessmen devote a large proportion of their energies.[2]

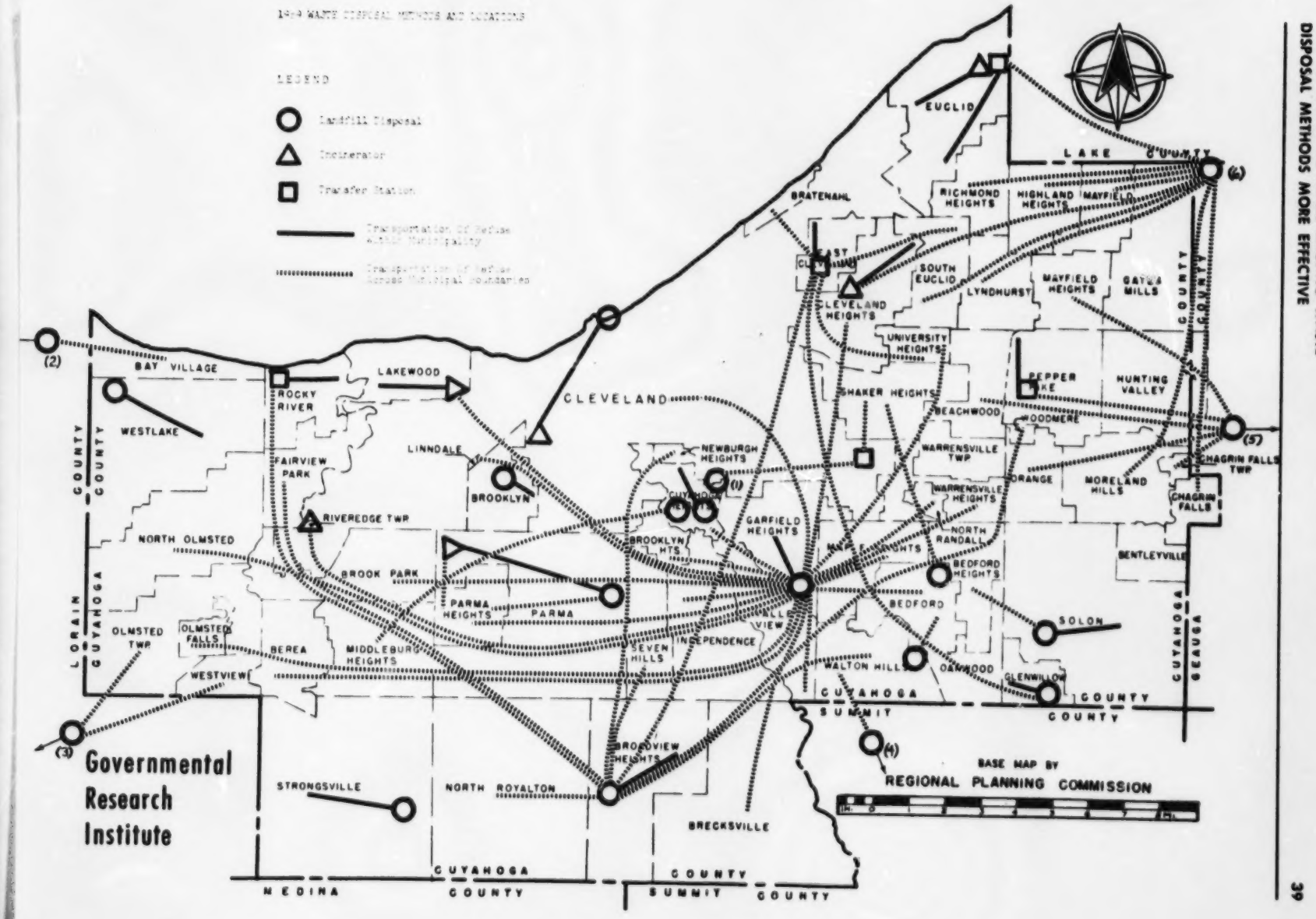
Fragmentation

Establishment of regional solid waste disposal organizations would reduce duplication of services and other operating problems resulting from governmental organization.

One of the biggest deterrents to solution of the solid waste disposal problem is the fragmentation of agencies responsible for coping with the problem. This was discussed by George Eagle, Chief Engineer of the Ohio Department of Health, in the July, 1969 issue of *Ohio Cities and Villages*. He identified fragmentation as perhaps the biggest deterrent to improvement in waste disposal, and attributed it to jealousies among local officials and their electors, especially in metropolitan areas.

Several consequences of the existing fragmentation of solid waste disposal operations include frequent disregard for the disposal needs of neighboring communities, lack of areawide jurisdiction, high cost of small-scale disposal operations, inability to raise revenues to finance efficient disposal facilities and services, and lack of planning and coordination with related environmental activities, such as sewage treatment and water supply.

2. "Summer Study on the Management of Solid Wastes," D. G. Wilson, ed., in *Resource Recovery Act of 1969*. Hearing before the Subcommittee on Air and Water Pollution of the U.S. Senate Committee on Public Works, Part 1, Washington, D.C., 1969, p. 97.


1969 WASTE DISPOSAL METHODS AND LOCATIONS
LEGEND
Landfill Disposal
Incinerator
Transfer Station
Transportation Of Refuse Within Municipality
Transportation Of Refuse Across Municipal Boundaries
EUCLID
LAKE COUNTY
BRATENAHL
RICHMOND HEIGHTS
HIGHLAND HEIGHTS
MAYFIELD
SOUTH EUCLID
LYNDHURST
MAYFIELD HEIGHTS
GATES MILLS
CUYAHOGA COUNTY
LEVELAND HEIGHTS
UNIVERSITY HEIGHTS
PEPPER PIKE
HUNTING VALLEY
SHAKER HEIGHTS
BEACHWOOD
WOODMERE
BAY VILLAGE
LAKEWOOD
ROCKY RIVER
CLEVELAND
WESTLAKE
LINNDALE
NEWBURGH HEIGHTS
WARRENSVILLE TWP
CHAGRIN FALLS TWP
FAIRVIEW PARK
BROOKLYN
CUYAHOGA
ORANGE
MORELAND HILLS
WARRENSVILLE HEIGHTS
CHAGRIN FALLS
RIVEREDGE TWP
NORTH OLMSTED
BROOKLYN HTS
GARFIELD HEIGHTS
NORTH RANDALL
BENTLEYVILLE
BROOK PARK
BEDFORD HEIGHTS
PARMA HEIGHTS
PARMA
BEDFORD
SOLON
OLMSTED TWP
OLMSTED FALLS
BEREA
MIDDLEBURG HEIGHTS
INDEPENDENCE
SEVEN HILLS
WALTON HILLS
OAKWOOD
GLENWILLOW
WESTVIEW
LORAIN COUNTY
CUYAHOGA COUNTY
SUMMIT COUNTY
BROADVIEW HEIGHTS
STRONGSVILLE
NORTH ROYALTON
BRECKSVILLE
MEDINA COUNTY
CUYAHOGA COUNTY
SUMMIT COUNTY
(1)
(2)
(3)
(4)
(5)
BASE MAP BY
REGIONAL PLANNING COMMISSION
Governmental Research Institute

Proponents of Regional Organization

Advocates of regional systems for solid waste disposal include engineers and public health officials, who stress the efficiencies and economies available through regionalization.

State and federal public health engineers and disposal experts, including the Ohio Department of Health, encourage the use of regional disposal systems. The Ohio Society of Professional Engineers has endorsed regional environmental control agencies and facilities for solid waste disposal, as well as for related problem areas of water pollution and air pollution control.

Dr. Anton J. Muhich, Director of Demonstration Operation, U.S. Bureau of Solid Waste Management, stated several reasons for regional solid waste management in a speech to the Ohio Municipal League's Solid Waste Management Forum in Columbus, May 22, 1969:

> Planning for solid waste management on an area-wide basis is of course essential to raising the overall level of sanitation services and for coping with our increased waste loads of the future. In many instances solid waste services are being provided by a unit of local government or special district that really is not large enough for the task. The county may frequently be the most desirable agent or governmental unit for administering solid waste services. Factors which may favor the county for this purpose include its political responsiveness to the desires of citizens in the area to be served and a sufficiently large area and population to achieve economies. Planning for a solid waste management system of optimum size may have additional technical advantages, such as allowing a wider choice of suitable disposal sites. Coordination of a solid waste program with air and water pollution abatement facilities is also facilitated at the higher levels.

Dr. Muhich's statement underscores the advantages that a county-wide or regional unit has over a smaller governmental subdivision: large geographical jurisdiction, ability to raise the revenues necessary to finance disposal facilities and services, functional jurisdiction over a number of related environmental activities, and responsiveness to area needs and areawide political influences.

A regional approach can also overcome site selection difficulty and extend the useful life of sanitary landfills in waste disposal. Soil, slope, drainage, and geological characteristics place physical limitations on the suitability of landfill sites. In urban areas the site problem is compounded by the relative scarcity of land, and the expense of land purchases.

Chapter V

PREVENTION OF WASTES

Solid waste disposal problems would be less severe if the production of wastes were greatly curtailed. State authority can be used in a variety of ways to reduce the production or use of that which becomes solid waste.

Earlier chapters set forth the nature and scope of the solid waste disposal problem, discussed existing methods and problems of disposing of solid wastes, and outlined the role which existing state, federal, and local law play in dealing with the problem. Clearly, finding adequate technological and administrative resources to dispose of the growing volume of waste products will require exceptional and expensive efforts. And, even if such efforts are made, the possibility remains that man's future well-being will be jeopardized by the problems which waste and its disposal creates. Therefore, the other alternative, that of not creating wastes (or at least, not as much wastes) must be given serious attention.

Several possible courses of action, ranging from programs which attempt to educate and persuade the consumer and producer to outright banning of particularly troublesome products and materials, are available. Such activities are not mutually exclusive; better effects may be achieved through a combination of approaches than through any single approach. Among the approaches to be discussed are:

1. *Material and Product Restriction*
2. *Economic Deterrents—Disposal Charges and Taxes*
3. *Economic Incentives to Reduce Waste Quantity*
4. *Product Research and Development*
5. *Consumer and Producer Education*

Material and Product Restriction

One of the most effective ways to reduce solid waste disposal problems would be to ban or restrict the production, sale, or use of products or materials in products that pose special disposal difficulties. Legislation to accomplish material and product restriction has been introduced in several states, but such legislation is currently in effect in only a few places.

A great increase in the use of nonreturnable bottles and cans and the concurrent increased use of materials which are not disposed of easily has focused attention on the possibility of banning such products or materials as a means of alleviating solid waste disposal problems. In particular, nonreturnable bottles and cans, multiple-alloy aluminum cans, twist-off bottle caps that leave an aluminum ring around the bottle neck, and polyvinyl chloride bottles have been identified for regulation. These items litter streets and roadsides, are difficult to collect and dispose of, and are increasing in use. The incineration of polyvinyl chloride bottles produces hydrogen chloride, which combines with moisture present in the air to form sulfuric acid, that in turn corrodes the incineration equipment.

Midwest Research Institute, in a report for the U.S. Bureau of Solid Waste Management, *The Role of Packaging in Solid Waste Management; 1966 to 1976* predicted that by 1976 nonreturnable containers will virtually displace the deposit type bottle. The report predicts a 16-fold increase in use of nonreturnable glass bottles, a 5-fold increase in the use of plastic bottles during the 1966 to 1967 period, both by volume and by weight, and a 3.7 per cent increase annually in use of metal cans. The following table from the Institute's report indi-

cates that the use of nonreturnable bottles and cans will double by 1976, while the use of returnables will decline from 2.5 billion units to 1.6 billion units during the 1966-1976 period.

TABLE V

BEER AND SOFT DRINK CONTAINER PRODUCTION BY TYPE OF CONTAINER AND USE: 1958, 1966, AND 1976 *

(In millions of units)

Type of container	1958	1966	1976
Nonreturnable containers:			
Bottles:			
Soft drink	192	1,980	13,500
Beer	1,239	5,031	8,600
Total	1,431	7,011	22,100
Cans:			
Soft drink	409	5,612	17,000
Beer	8,337	12,947	19,000
Total	8,746	18,559	36,000
Nonreturnable total	10,177	25,570	58,100
Returnable containers:			
Soft drink	1,240	1,922	1,200
Beer	388	577	460
Returnable total	1,628	2,499	1,660
Total containers	11,805	28,069	59,760

*Source: Midwest Research Institute

The Midwest Research Institute packaging report suggests that to be effective in reducing litter or in promoting use of reusable or salvageable containers, legislation should (1) prohibit all nonreturnable container types currently used for a certain commodity; (2) require a deposit costly enough to induce the consumer to return the container; (3) provide for the ban of new container types which may appear in response to the prohibition, for example, plastic bottles.

To date, most of the emphasis has been placed on the reuse of beverage containers, largely because there are so many such containers and because consumers have been switching from returnable to non-returnable containers. The basic principle, that returnable containers be used, could be expanded to encompass most products, including those which historically have not utilized returnable containers.

A related approach is that of regulating the quantity and types of materials used in packaging. For example, the state could require that packaging materials be biodegradable (decompose quickly upon exposure to the elements), combustible, or compressible. Such requirements would raise questions of technological feasibility, and social desirability. An absolute requirement that packaging materials be biodegradable would in effect ban metal and glass containers altogether. Even plastics cannot currently meet such a requirement. A Swedish-make polyvinyl chloride plastic bottle, claimed in 1968 to "dissolve" after two years' exposure to the elements and once hailed as a solution to the world's trash-disposal problem, was rejected for use by interested Swedish and American brewers, when they learned that these polyvinyl chloride bottles did not disintegrate and would have to be burned or

buried.[1] Yet, disposability standards might provide an incentive toward the development of more easily disposable materials.

The packaging report mentioned earlier explored and rejected the alternatives of regulating quantity and types of materials used in packaging, because such regulations might cause arbitrary disruption throughout the national economy and impose an immense enforcement chore. It suggested, for example, that prohibition of nonreturnable glass bottles could undoubtedly create a vast market for metals and plastics. If plastics should capture a large share of glass markets, new plastic production facilities might be built. Plastic prices might fall, making plastics more competitive with paper. As plastics begin to displace paper, the disposability of packaging materials would deteriorate. Further regulations, aimed this time at plastics, might then be needed.

Minimum durability standards for automobiles, refrigerators, washers, TV sets, and other major appliances have been suggested as a means of reducing the volume of waste created when such products are discarded. If such products have greater durability, they will be utilized longer and fewer of them will be available as waste products. Little information is available as to what standards might be prescribed, how feasible they might be, and how much they would serve to reduce the total volume of waste products.

Most of the proposals which have been made to date are concerned with beverage containers. Regulation of beverage container types was proposed in 19 states in 1967. Altogether 32 proposed laws were presented, but none was passed. The only state enacting such legislation was Vermont, which prohibited the sale of beer and ale in throw-away bottles in 1955, but repealed the ban in the following year, because the beer industry there simply switched to cans, which created as much of a litter problem as bottles. In 1970 the Canadian province of British Columbia banned nonreturnables and imposed a minimum 2¢ deposit on returnable beverage containers. Several U.S. cities and counties have imposed similar restrictions.

Economic Deterrents — Disposal Charges and Taxes

Disposal charges or special taxes on products which cause special solid waste problems have been posed as an alternative to banning their use. Such charges could serve to discourage the use or production of the item or at least to pay the costs of meeting disposal problems.

Many persons who do not approve of regulation or feel that regulation might result in new problems or inequitable solutions advocate the use of economic means to obtain the same results. Their proposals are of two related types: One is to discourage the production or use of an item which causes waste disposal problems by taxing it at rates which make its use uneconomical. The second is to tax it or assess a charge on it which will reflect in some way the cost of disposing of the item.

In the first instance a tax on nonreturnable containers or on containers such as the polyvinyl chloride plastic bottle might be set at a level which would encourage use of returnable containers or of more readily disposable containers. Opinion on the usefulness of such measures is divided. Some feel that higher prices would encourage use of equally undesirable alternatives. Others point to existing purchasing patterns which seem to demonstrate that people will pay considerably more for the ingredients when offered the privilege of not having to return a beverage container. Special taxes, however, could increase the price difference to a point where few consumers would want to purchase items sold in "no-return" containers.

A growing number of economists and scientists advocate disposal charges. Resources for the Future's Allen V. Kneese, Harvard University's Kenneth J. Arrow, John Kenneth Galbraith, and others have professed that the traditional free-market system of pricing fails to reflect the costs of pollution and environmental damage resulting from waste disposal.

1. *Wall Street Journal*, Wednesday, January 9, 1969.

Kneese estimates that pollution from wastes costs society tens of billions of dollars annually. These costs include estimates of the medical care, water treatment, and other environmental improvement programs necessary to restore environmental quality. Earl Finbar Murphy, professor of environmental law at Ohio State University, argues:

> What is needed in any modern economy . . . is an institutional ability to specify the demands the economy makes upon its environment and to internalize those costs.[2]

Putting it simply, persons who bring waste products into being should pay for the environmental damages caused by their wastes and discarded products. Economists have been seeking some method of motivating manufacturers and other users of renewable resources to consider environmental quality **before** selecting materials and methods of production and disposal. The disposal charge attempts to make producers and resource users pay for the environmental damages or disposal burden they create.

In a different but related area, for some time disposal charges have been imposed on wastes discharged into streams in several foreign countries; Vermont was the first U.S. state to authorize similar disposal charges by law in 1970. The prototype plan for such charges is the Ruhr Valley Association or "Ruhrverband" in Germany. Each polluter is charged for the amount and quality of effluent he discharges into a steam. The amount of each effluent charge is computed on the basis of its impact on the water quality of the receiving stream, treatment needs, and water uses downstream. The amounts paid as effluent charges are earmarked for water treatment within the Ruhrverband's jurisdiction.

Some argue that the effluent charge system could be utilized to pay for solid waste disposal. There have been a number of proposals for the imposition of disposal charges at the national level and in other states. A tax of one cent per pound on manufacturers of products which wind up as waste within 10 years was recently proposed by Leonard S. Wegman, a consulting engineer active on the New York Board of Trade's Business Council on Environment. U.S. Senator Gaylord Nelson has introduced a bill calling for a schedule of national packaging disposal charges. Senator Nelson's bill, S 3665, directs the Secretary of the Treasury to set disposal charges for all packaging that results in solid wastes or adverse environmental effects. The bill directs that the charges set reflect whether the packaging is made from virgin or used materials, the quantity of wastes resulting from the packaging, its effects on health and the natural environment, its degradability, and the likelihood the packaging will be returned and reused, or salvaged. A bill adapted from Senator Nelson's measure was introduced in the Ohio Senate a few days before the end of the 1970 session (S. B. 590).

One of the main difficulties in imposing disposal charges is the complexity of setting different rates for each material so as to reflect its environmental damage or disposal cost accurately. To develop an optimally effective schedule of charges (one that will induce the cheapest pattern of waste prevention measures necessary to meet air and water quality standards), accurate information is needed that reflects the actual cost of waste reduction by firms. This type of cost data is not readily available at present. Also, the economic consequences of each rate would be difficult to predict. Consider this example from the Midwest Research Institute's packaging study for the U.S. Bureau of Solid Waste Management:

> A tax on metal cans would have different effects depending on what is taxed. A general tax would probably have no effect [on the choice of materials]. If it is levied only on tin-plated steel cans in order to bring about a switch to tin-free steel, it would probably accelerate commercialization of such a container. A tax on aluminum cans could result in a switch to steel if the tax is high enough; aluminum and steel cans compete for beverage markets on the basis of cost, performance, and consumer preference. If the tax is nominal, aluminum manufacturers would most likely absorb it. A tax on aerosol dispensers would

2. Earl Finbar Murphy, *Governing Nature*, Quadrangle Books, Chicago, 1967, p. 22.

> almost certainly be passed on to the consumer—who chooses the more expensive aerosol form of a product because of its convenience, not its price.[3]

Disposal charges may have unpredicted and undesirable results (for example, taxing glass bottles might simply result in more discarded plastic bottles and high unemployment in the glass manufacturing industry). Other difficulties involved in the imposition of disposal charges include the possibility that they would be unwieldy to enforce or collect. Some economists fear that it is quite unlikely that disposal charges would be set high enough to be an effective deterrent. (The Ruhr Valley disposal charges have not prevented the pollution of the Ruhr; they have, however, produced revenues for water treatment.)

Economic Incentives to Reduce Waste Quantity

Relatively little thought and effort has been given to the possibility of finding economic incentives for reducing solid waste disposal quantities. A first step could be taken if the state applied disposability standards to its own purchases.

Many observers feel that the best way to obtain a desired result is to give someone an economically desirable reward for doing what is socially desirable. Accordingly, tax incentives and subsidy programs have been urged and implemented to help obtain desired results. Ohio, for example, exempts air and water pollution treatment facilities from taxation in the hope that this will encourage the installation of such facilities. Federal and state subsidies are also used to induce individuals and governments to adopt particular policies.

In the course of this study, no such incentives were suggested as a method of reducing solid waste. (Presumably one could suggest subsidizing products having a longer useful life, or economic incentives for the use of returnable glass containers, but no one has; nor have any reasons been presented as to why economic incentives might be more effective than regulation or economic deterrents.) Economic incentives toward recycling wastes (as distinct from reuse of products) are discussed in Chapter VI.

One type of economic incentive which has not been discussed involves use of the state's purchasing power. Disposability characteristics might be written into specifications in invitations for bids on major procurement contracts. Ohio state government itself is one of Ohio industries' biggest consumers. Its purchasing power might be applied to require, for example, that aluminum oil and beverage cans furnished the highway department or state institutions be made from a single alloy, or that such products be delivered in returnable containers.

The net effect of such a purchasing policy on over-all consumption patterns is difficult to estimate.

Product Research and Development

New products, developed through research, could be useful in reducing solid waste disposal problems. The state could sponsor or subsidize such research and development.

Some noted scientists have called on industry to conduct research on solid waste disposal. In 1967, Dr. Athelstan Spilhaus of the Franklin Institute in Philadelphia, (now President of the American Association for the Advancement of Science,) said that the next goal of the auto industry, for the benefit of civilization, should be to make a vehicle that can be mass-disassembled and mass-reused. Then, he said, we should apply the same principles to refrigerators, washing machines, vacuum cleaners, old television sets and other products that find their way into the refuse truck when they have outlived their usefulness. In a September, 1969, special report, the editors of *Business Week* forecasted:

3. Arsen Darnay and William E. Franklin, *The Role of Packaging in Solid Waste Management 1966 to 1976*, Midwest Research Institute, for the Public Health Service, U.S. Department of Health, Education, and Welfare, Rockville, Maryland, 1969, pp. 159 and 160.

> The (automobile) companies will keep an active interest in a car even after it becomes the property of the consumer. One possibility: getting rid of junk cars. Both Chevrolet and Ford already are buying some to remelt.[4]

Today many individual corporations and industry and trade associations are investing their own moneys in research: on methods for salvaging and reusing their products. *Business Week* believes industrial leaders are responding to the growing tide of consumer concerns and seeking broader social involvement. The special report quotes General Motors Corporation chairman James M. Roche in summing up industry's changed outlook and the benefits that might be obtained from governmental cooperation in industrial research.

> Business and government can ill afford to be adversaries. The success of each largely depends upon the other . . . The question upon which depends so much of America's future is this: Can free government and free business—each faithful to its purpose—work together to serve our nation's greater interest? Can we make free enterprise equal to these new challenges?

This raises the question: should public funds be used to conduct or subsidize research for industry, or should industry conduct its own research with its own funds? Proponents of government grants or research for industry contend that solid waste disposal is a community problem, and that the tax resources of the community should be applied wherever improvements in disposal practices may be achieved, including private industry. Opponents of such grants or research argue that industry bears the responsibility for disposal of the products it offers to society, and if industry's products contribute to pollution and waste, industry should bear all responsibilities, including financial responsibility, for dealing with the problems it creates.

If government is to aid industrial research, then the state might provide grants to industry to conduct research and development on products and packaging methods which reduce solid waste. Alternatively, research on product and packaging waste problems could be performed by the Ohio Department of Health, universities, or by private research firms under state contracts.

To some extent the philosophic arguments over who should pay the cost may be determined by more practical considerations such as:

> 1. How much is the public interest involved in solving the particular problem?
> 2. What resources are available to the affected industry to conduct research on the specific problem?
> 3. What economic advantage will adhere to the industry which receives the benefit of any such new product research and development?

In all probability there will be instances where application of such criteria may dictate a need for state involvement in research and development in much the same way as some states and the federal government have sponsored research in highway safety products and in mass transportation.

Consumer and Producer Education

Consumer and producer education is frequently proposed as a means of changing purchasing and production patterns relative to products which create solid waste disposal problems. Little is known about its effectiveness, but some evidence suggests that a strong public information program can influence producers' activities.

Consumer information on the specific disposal problems occasioned by products and practices and the alternatives for solving them could be provided by the state. The Midwest Research Institute's study on packaging for the U.S. Public Health Service identified public unfamiliarity with disposal problems as one of the main obstacles to improvement. The report recommended educational efforts directed toward consumers, government agencies, and industry generally, including waste disposal facility operators.

4. *Business Week*, September 20, 1969, pp. 110-119.

Despite the sparse experience with public-sponsored consumer education programs on solid waste problems, consumer education appears likely to yield significant results. Its potential appears great, especially for influencing consumer choices against specific products and brand names that pose particular disposal problems. The threat of TV or newspaper exposure may move abusing industries to improve their products with respect to waste disposal characteristics. To some extent, adverse publicity with respect to cigarettes served to cause manufacturers to produce lower tar and nicotine products and to affect consumption habits.

A wide variety of consumer education suggestions could be developed to bring pressure on the greatest solid waste producers, for example:

Buy containers that can be recycled, either for use within the home, or by industry. Take returnables back to the store.

Take nonreturnable containers — bottles, cans, paper, and plastic packaging — back to the store, ask the store manager to return them to the manufacturer for recycling, and favor stores that accept nonreturnables.

Avoid purchasing products in double packages (tubes and jars within boxes, for example) and send complaints about such packaging to their producers. Buy meats and groceries in bulk.

Avoid products that create large quantities of wastes: paper cups, plates, and napkins; plastic tableware; pampers; phosphate-base detergents, etc.

Institute vegetable gardens and other "do-it-yourself" and "grow-your-own" practices. Start a backyard compost pile. Try "organic" gardening and avoid buying chemical fertilizers.

Store old newspapers, magazines, cans, and bottles separately for return and salvage.

Become aware of companies making efforts to alleviate disposal and pollution problems and favor them with your business.

Chapter VI

IMPROVING DISPOSAL PRACTICES

Some form of state assistance or state legislation is needed if uniform, efficient, and effective solid waste disposal practices are to be implemented.

The preceding chapter considered several approaches to preventing or reducing the volume or severity of waste disposal problems. Such efforts could significantly affect the volume of waste produced or cause that which is produced to be more easily disposed of, but they would not eliminate the problem of waste disposal. Clearly, a heavily populated, highly technological society will continue to have as a by-product of its operations a large volume of wastes to dispose of. This chapter is concerned primarily with what might be done to reduce the problems involved in disposing of large volumes of waste.

This report has already discussed a number of means of disposing of waste. They ranged from the highly unsanitary and unsatisfactory practices of open dumping and burning of trash, through use of sanitary landfills, incinerators, and "trash trains" to haul trash to remote landfills, on to more expensive approaches such as compacting, sorting and recycling, and using waste materials as fuels or components of new products. This chapter explores ways in which the state might encourage the use of one or more of these practices.

A major deterrent to better solid waste treatment or disposal practices is cost. Many jurisdictions in Ohio do not have the financial ability to pay for an effective waste disposal program. Some programs, which might be considered more desirable than others (because they create less ultimate waste) are more costly and are discarded as uneconomical. But such economy may be illusory. Future Ohioans may find that the more expensive solutions were, in the long run, more economical.

To some extent, the problem of cost is a problem of government organization. Often the unit of government responsible for a waste disposal operation is not an economically viable entity to perform the function. For example, many townships and villages may not be able to afford the cost of a trash pickup and sanitary landfill operation. Smaller cities may not be able to afford compacting machinery or incinerators which do not materially pollute the atmosphere. Even the largest cities may find the costs of equipment which sort trash for recycling or the costs of "trash trains" prohibitive. Accordingly, wider-based, wealthier and more efficient entities may be needed.

The remainder of this chapter considers means whereby the state, through more effective organization or special financing, can cause improvement in waste disposal practices.

REGIONAL DISPOSAL FACILITIES

State operation of regional disposal facilities would make it possible to utilize a wider range of disposal techniques than any single community could afford.

The state could acquire or construct and operate disposal facilities on a regional basis. The Department of Health could make the necessary surveys of types and quantities of wastes generated, and undertake systems analysis and cost effectiveness studies to ensure that the location and methods for disposal (incineration, landfill, or other methods) would yield economical and efficient operation. The "regions" would need to be large enough to

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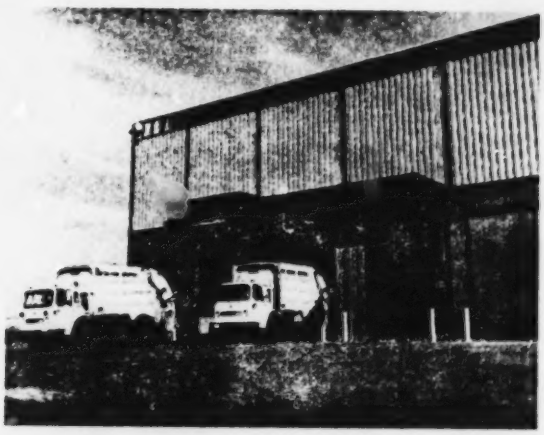

City refuse trucks at county incinerator

Transfer station for temporary storage and transportation to regional disposal site

process large volumes of wastes regularly; a Massachusetts Institute of Technology study group suggests at least 1,000 tons a day.[1] For example, the state itself could operate the disposal facilities, transfer stations, and related equipment. Local government units could continue to perform collection services by collecting wastes from homes, offices, and plants and transporting them to the transfer stations or disposal sites. Temporary storage and transfer facilities could be provided at convenient locations to serve rural areas if collection services were found to impose an undue cost burden, as they might in sparsely populated southeastern Ohio counties.

1. The MIT study group consulted experts on disposal and personally visited many technologically advanced disposal operations in the United States and Europe, during the summer of 1968. They found that communities disposing of 200 tons a day have difficulty in keeping disposal costs at $10 per ton or less, and that several types of facilities that handle 2,000 tons a day are capable of bringing disposal costs to below $5 per ton. Many other studies support the recommendation for regional facilities; the MIT group has been more specific than others in identifying a limit (1,000 tons per day) — a limit which, it must be conceded, is arbitrary and perhaps should be modified for Ohio. The MIT group concerned itself primarily with waste disposal in the urban regions of the United States and western Europe. The 1,000 ton a day limit may be applicable in Ohio's urban areas (to the extent that Ohio's urban waste problems are similar to those of the nation generally). The limit is probably less applicable in Ohio's rural counties.

Such a proposal is being practiced with respect to disposing of abandoned junk automobiles in Vermont. Municipalities and towns there inventory their abandoned junk autos, select suitable collection areas, and haul them to the collection points, often with voluntary donations of money, trucks, and labor. The state of Vermont guarantees to dispose of the cars once the collection has been completed.

The Ohio Society of Professional Engineers has made a similar but more comprehensive proposal. They suggest the creation of regional environmental control agencies that would enforce environmental quality standards and operate water and sewage treatment and air quality improvement facilities, in addition to solid waste disposal facilities.

LICENSES AND PERMITS

State laws relating to solid waste disposal could be extended to regulate the practices of industries and firms currently exempted.

The Solid Waste Licensing Law does not cover industries and commercial firms that dispose of their own wastes on site, scrap processors, junk dealers, building demolition firms, construction firms, mining firms, and farms.

Some of these waste producers handle hazardous substances such as chemicals and drugs, and others are involved in operations such as food processing which could, if improperly handled, cause serious health problems.

Regulation could be extended to include every person and firm that disposes of solid wastes in any appreciable quantity on a regular basis. Regulation might be provided by extending the scope of the existing licensing law, so that there are no exemptions. Or, a system of permits from the state Department of Health or an environmental protection agency, similar to an oil or gas drilling permit or a Water Pollution Control Board permit to discharge effluent into an Ohio stream, could be required by law, perhaps by amending the industrial waste discharge permit law to extend to the disposal of solid waste products. To enable enforcement by citizens and law enforcement officers generally, violations of permits or licenses could be made criminal offenses. Citizens and conservation organizations could be permitted to seek injunctions for violations. Permit and license fees and fines for violation could be earmarked to pay the salaries of state or local enforcement personnel and to defray the legal expenses of persons injured by permit violators.

IMPROVED STATE ENFORCEMENT THROUGH AN ENVIRONMENTAL PROTECTION AGENCY

State regulation and enforcement of solid waste disposal laws might be improved if such activities were assigned to an agency which had over-all responsibility for all forms of environmental protection.

Currently, at least ten different Ohio state agencies are involved in the enforcement of various regulations designed to protect the quality of the natural environment (at least in part). The three principal regulatory measures — air, water, and solid waste disposal standards — are each administered in separate agencies, each with a handful of staff (counting clerical employees). The Health Department has roughly 40 professionals — principally engineers and sanitarians — assigned to air and water pollution control and solid waste disposal activities, throughout its Columbus divisions and four district offices. The Ohio Air and Water Pollution Control Boards rely exclusively on these professional personnel for enforcement of environmental standards at the state level. In comparison, the Illinois Environmental Protection Agency had 272 employees in October, 1970, and plans to expand to about 550 employees by July, 1972. The Illinois agency was appropriated $6 million for its fiscal year 1970 operating budget. The state of Wisconsin has some 100 professional personnel for the enforcement of comparable environmental quality functions within the Division of Environmental Protection of the Wisconsin Department of Natural Resources. The Minnesota Pollution Control Agency, which regulates air, water, solid waste, and nuclear power plant wastes, has 75 professional personnel.

Other regulatory functions in Ohio are assigned by law to the Natural Resources Department (strip-mine reclamation, oil and gas drilling, and stream littering), and the Agriculture Department (pesticides and other economic poisons, animal carcass rendering plants, and facilities for feeding garbage to hogs). Several of these functions employ sizeable staffs, for example, all game protectors are assigned statutory responsibility to enforce the stream littering prohibition.

TABLE VI
MAJOR OHIO REGULATIONS FOR THE PROTECTION OF ENVIRONMENTAL QUALITY

Activity	Revised Code Citation	State Enforcement Agency
1. Air Quality	a. Chapter 3704	a. Air Pollution Control Board
	b. Section 3723.01	b. Ohio - West Virginia Interstate Air Pollution Control Comm.
	c. Section 3723.04	c. Ohio-Kentucky Air Pollution Control Comm.

Activity	Revised Code Citation	State Enforcement Agency
2. Water Quality	a. Chapter 6111	a. Water Pollution Control Board
	b. Chapter 6113	b. ORSANCO (Ohio River Valley Water Sanitation Commission)
	c. Chapter 6161	c. Great Lakes Commission
3. Solid Waste Disposal Facilities	Chapter 3734	Health Department
4. Water-borne Industrial Wastes	Sections 3701.19, 3701.20, and 3701.59	Health Department
5. Feeding Garbage to Swine and Poultry	Chapter 942	Agriculture Department
6. Disposal of Liquid Wastes Underground	Section 1509.05	Natural Resources Department
7. Rendering Plants	Chapter 953	Agriculture Department
8. Pesticides and other Economic Poisons	Chapter 921	Agriculture Department
9. Radiation	Sections 3701.93-99	Health Department
10. Noise Control	(No law)	(Not Regulated by State)
11. Stream Littering	Sections 1531.29 and 3767.32	Natural Resources Department
12. Highway Littering and Other Nuisances	Section 3767.20	(None)
13. Canal Littering	Section 123.75	Public Works Department
14. Junkyard Screening	Section 4737.05	Highway Department
15. Oil and Gas Drilling	Chapter 1509	Natural Resources Dept.
16. Fertilizers and Liming Materials	Chapter 905	Agriculture Department
17. Strip Mine Reclamation	Chapter 1513	Natural Resources Dept.
18. Wildlife, Fish, and Game	Chapter 1531 and 1533	Natural Resources Department
19. Forest Fire Control	Chapter 1503	Natural Resources Dept.
20. Shore Erosion	Chapter 1507	Natural Resources Dept.
21. Dredging in Lake Erie	Section 1505.07	Natural Resources Dept.
22. Rural Zoning	Chapters 303 and 519	(No State Supervision or Review)

In addition, several other functions closely related to environmental protection are scattered among separate administrative agencies. Water basin development planning encompasses the planning work necessary to provide water supply (for household, industry, and farm uses), flood control, and water-based recreation (swimming and boating) — all of which are closely related to water quality. Despite the substantial effects that water improvements (dams, treatment plants, stream channel modifications) have upon water quality, water basin development planning is conducted by the Division of Water in the Department of Natural Resources, independent of the Water Pollution Control Board and its enforcement personnel in the Department of Health. Soil and water conservation programs are assisted by the Ohio Soil and Water Conservation Commission in the Department of Natural Resources. State financial assistance for water improvements and solid waste disposal facilities is administered by another separate agency, the Ohio Water Development Authority. Moreover, still another separate and independent agency, the Ohio Air Quality Development Authority, administers state financial assistance for air quality improvement facilities and equipment.

Environmental protection activities might be centralized in Ohio, within a single administrative agency, as has been proposed at the Federal level and in several other states. President Nixon on July 9, 1970 submitted a plan to the Congress requesting establishment of an Environmental Protection Administration (EPA).

On December 2, 1970, the EPA took over responsibility for water quality programs from the Interior Department, for air quality and solid waste disposal from the Department of Health, Education, and Welfare; for pesticide control from the Food and Drug Administration and the Department of Agriculture; and for radiation standards from the Atomic Energy Commission. The new agency was adapted from recommendations by President Nixon's Council on Executive Organization, headed by Litton Industries' president Roy L. Ash. Similar legislation was introduced earlier by Senator Edmund S. Muskie, Senator Hugh Scott, and other Congressional leaders from both major political parties. Action to centralize environmental protection activities at state levels during the last two or three years is under consideration in many states, and has recently been taken in several states, such as Illinois, New York, and Wisconsin, but such action is too recent to evaluate their experience meaningfully.

In the absence of experience, one must rely heavily upon a close examination of the rationale or purpose for such organizational proposals in order to evaluate their effectiveness. When presenting his proposal for a national EPA to Congress, President Nixon explained the basis of his reorganization plan as follows:

> . . . the sources of air, water and land pollution are interrelated and often interchangeable. A single source may pollute the air with smoke and chemicals, the land with solid wastes, and a river or lake with chemical and other wastes. Control of air pollution may produce more solid wastes, which then pollute the land or water. Control of the water-polluting effluent may convert it into solid wastes, which must be disposed of on land.
>
> Similarly, some pollutants—chemicals, radiation, pesticides — appear in all media (air, water, and land). Successful control of them at present requires the coordinated efforts of a variety of separate agencies and departments. The results are not always successful.[2]

The President claimed that a far more effective approach to polution control would:

> —Identify pollutants.
>
> —Trace them through the entire ecological chain, observing and recording changes in form as they occur.
>
> —Determine the total exposure of man and his environment.
>
> —Examine interactions among forms of pollution.
>
> —Identify where in the ecological chain interdiction would be most appropriate.

In organization terms, this requires the centralization into one agency (the EPA) of a variety of research, monitoring, standard-setting and enforcement activities at the national level.

There are several approaches the General Assembly might take to reorganize environmental control activities at the state level. If a consolidated agency is desired along the lines of the national EPA, the following regulatory activities might be consolidated into a single agency: air and water pollution; solid waste disposal; water-borne industrial wastes; feeding garbage to swine and poultry; rendering plants; pesticides and other economic poisons; radiation; and noise control. Water basin development planning and the administration of state financial aid programs for waste treatment facilities to abate and control air, water, and solid waste pollution might also be consolidated in a state-level EPA so that planning and financial assistance activities could be better coordinated with enforcement activities.

Further study of existing and alternative organizational arrangements for making environmental protection activities more effective is needed if a consolidated approach is to be followed. In Michigan, the Governor has directed his Council on Environmental Quality to analyze the organizational structure and relationships of existing state agencies involved in environmental protection and to specifically examine the feasibility of creating a new Department of Environmental Protection.

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2. The July 9, 1970 message of the President is printed in *Reorganization Plan No. 3 of 1970*, Hearings before a Subcommittee of the U.S. House Committee on Government Operations, Washington, D.C., 1970, pp. 2-11.

MOBILIZING LOCAL ACTION

The state could encourage local action on solid waste disposal by mandating certain functions and responsibilities for local governments, and by providing local governments with financial assistance. The financial assistance might be applied effectively to help local governments obtain, construct, or improve solid waste disposal facilities.

Chapter III's discussion of enabling legislation indicated a lack of cooperative or joint action despite permissive legislation. The absence of joint efforts begs consideration of ways to require or encourage local action. Several possibilities are discussed under the headings of assigned local service responsibilities and financial assistance. Technical assistance is already provided by the Department of Health.

Assigning Local Responsibility

Local action could be stimulated by mandating larger units of local government to plan for and provide disposal facilities and, conversely, restricting smaller units from operating disposal sites.

Counties could be required to plan and operate disposal facilities and municipalities and townships to contract for collection services. Or, all cities above a statutorily specified population could be required to provide household garbage and refuse collection and disposal services, and all counties could be required to provide such services in the remaining areas. Or less populous counties, townships, and municipal corporations could be prohibited from operating disposal facilities unless they join with larger neighboring subdivisions to provide facilities that will serve a specified minimum population (say 40,000 inhabitants) or a specified minimum quantity of wastes (such as 1,000 tons a day). These limits specified correspond with Massachusetts Institute of Technology's estimates for the smallest facilities that can operate at costs of $10.00 or less per ton of wastes processed.

A Massachusetts legislative study committee recently recommended a similar proposal. In 1970, the Massachusetts Legislative Research Council recommended that counties be made responsible to operate disposal services, and that municipalities and towns be made responsible for garbage and refuse collection.

Major city, county, and regional planning commissions could be required to survey and design facilities for handling all solid wastes within and throughout their respective jurisdictions. This could be done without necessarily requiring them to provide regional disposal facilities or collection services.

Financial Assistance

Financial aid could be provided for the construction of disposal facilities, for the planning of disposal systems, for research and demonstration projects, and for the reclamation of abandoned dumps.

Facility construction. Disposal facility needs throughout Ohio over the next five years are very roughly estimated to cost approximately $60,000,000. Since virtually all Ohio communities face expenditure needs to finance facility improvements, the state might subsidize their cost. State aid could be made contingent on a community's meeting certain requirements, such as (1) the facility meets environmental quality standards, (2) it is located so as to minimize environmental damage, (3) the project serves a sufficiently large region or population, or (4) cost-benefit analyses show the facility to be superior to alternative disposal methods. In the case of federal-aided facility construction projects, a state subsidy would help meet the local share of project costs, thereby enabling state and local dollars invested to fund additional disposal projects. Although state aid in issuing revenue bonds for disposal facilities was authorized in 1970, Ohio's major cities and rural communities may not choose to use revenue bond financing for disposal facility construction purposes, since they finance disposal activities from tax revenues, and the imposition of user charges would in-

flict an economic hardship on their large numbers of low-income inhabitants.

Plans for disposal systems. Few county or regional planning agencies and major city planning departments have prepared surveys of their areas for the purpose of ascertaining the quantities and physical characteristics of all wastes, and locating physically suitable sites for meeting present and future disposal needs. The state could assist in financing such planning surveys. In Pennsylvania, where state law requires all municipalities with a population density of 300 or more inhabitants per square mile to prepare solid waste disposal plans, the state reimburses up to 50 per cent of the costs of preparing each plan. This arrangement has sparked considerable disposal planning activity since it took effect January 1, 1969, and was cited as an exemplary approach by the National Association of Counties.

Research and development. State aid could be extended to demonstration type disposal projects that are likely to have many applications in Ohio and elsewhere. The U.S. Bureau of Solid Wastes has identified disposal technology and salvage methods as two areas in which research and demonstration type efforts would be highly fruitful. Examples of disposal technology needs in Ohio are the development of economical methods of incineration for small communities, the design of cheap, safe methods for transferring wastes from storage containers to collection vehicles, and the disposal of sewage sludge or the wastes of particular Ohio-based industries: steel, glass, rubber, or detergent manufacturing, for example. Research on salvage techniques in Ohio might also include application of several potential methods for separating materials from raw wastes or incinerator residue, such as using magnets, flotation, precipitation, centrifuges, filtering, and optical or electronic sensing devices.

Abandoned dump reclamation. Chapter II noted that many of the 400 disposal sites that have simply been abandoned and the leachate from these sites constitute nuisances that are likely to persist for 25 years or longer. Some form of state subsidy to municipal corporations, townships, and counties might be considered to help defray the expenses of reclaiming these sites.

ECONOMIC INCENTIVES TO RECYCLE WASTES

A state policy which encourages the recycling of waste products could result in a material reduction in the amounts of wastes which must ultimately be disposed of.

As noted earlier, practices such as sorting and reclaiming materials, or burning trash to create electric power, tend to be relatively expensive procedures. However, if the public interest in reducing disposal problems is sufficiently great, such practices may become necessary. One way of accomplishing this is for governmental disposal facilities to do the necessary sorting and preparation. Alternatively, attempts could be made to encourage industries to take more initiative in utilizing recycled waste products.

Direct subsidies could be paid to scrap processors and salvage industries, for the purpose of encouraging greater use of secondary (salvaged) materials. Subsidies could also be paid to industries for their use of secondary materials — probably in the form of price support so as to lower the cost of used materials vis-a-vis raw materials. Tax credits could be offered industries that dispose of or salvage their own wastes, thereby achieving indirectly the effect of a direct subsidy. The state's purchasing power could be applied by writing disposability requirements into specifications for state procurement contracts.

Some form of subsidy for scrap processing and salvage operations appears to be the most likely alternative for application at the state level. Several cities — for example, St. Petersburg, Florida, and Houston, Texas — pay commercial scrap processing plants a few dollars per ton of garbage and refuse handled. The plants salvage and sell whatever they can, for whatever price the markets will bear and dispose of the rest by conventional disposal methods. The payments per ton paid by the cities

make up the difference between the plants' income and costs. A few states have recently provided subsidies to cities to dispose of abandoned junk automobiles. There is little experience to date with these subsidy arrangements, however. Before providing a state subsidy directly to salvage industries, investigation would be necessary to determine the exact levels of support that would result in maximum recycling at an acceptable cost, and to compare the cost benefits of such supports with cost of public waste disposal operations.

Direct subsidies and tax credits to industries that salvage or dispose of their own wastes do not appear feasible at the state level, but might be more effective if applied nation-wide. A great deal of investigation of industrial processes would be necessary to determine which production processes merit subsidization or tax credits. A price support form of subsidy would also require detailed economic research, and if applied in only one state, might create peculiar economic disadvantages for that state.

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